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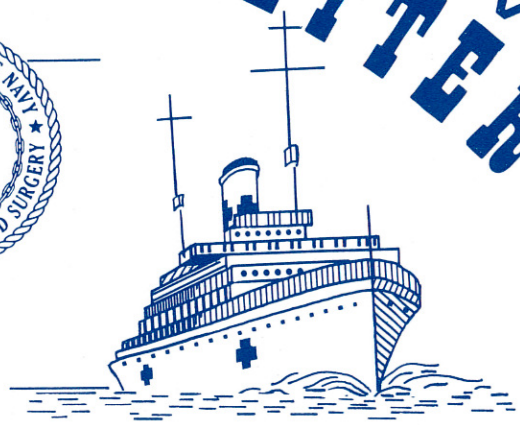
UNITED STATES NAVY MEDICAL NEWS LETTER



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United States Navy
MEDICAL NEWS LETTER

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Policy

The U.S. Navy Medical News Letter is basically an official Medical Department publication inviting the attention of officers of the Medical Department of the Regular Navy and Naval Reserve to timely up-to-date items of official and professional interest relative to medicine, dentistry, and allied sciences. The amount of information used is only that necessary to inform adequately officers of the Medical Department of the existence and source of such information. The items used are neither intended to be, nor are they, susceptible to use by any officer as a substitute for any item or article, in its original form. All readers of the News Letter are urged to obtain the original of those items of particular interest to the individual.

Change of Address

Please forward changes of address for the News Letter to Editor: Bureau of Medicine and Surgery, Department of the Navy, Washington, D.C. 20390 (Code 38), giving full name, rank, corps, old and new addresses, and zip code.

The issuance of this publication approved in accordance with NAVEXOS P–35.

SPECIAL ARTICLE

ADMIRAL ALBRITTAIN NAMED DEPUTY SURGEON GENERAL

Rear Admiral John W. Albrittain, MC USN, assumed duties as Deputy Surgeon General of the Navy and Deputy Chief, Bureau of Medicine and Surgery, in February 1969.

Admiral Albrittain succeeds Vice Admiral George M. Davis, Jr., who became Surgeon General on 1 February 1969.

Admiral Albrittain was formerly the Commanding Officer, Naval Hospital, Great Lakes, Illinois.

Rear Admiral Albrittain was born in La Plata, Maryland, on April 30, 1911, the son of the late Alberta M. and Warren M. Albrittain. He received his early education in the public schools of Charles County, Maryland, and completed his pre-medical studies at the University of Maryland, College Park, Maryland, in 1931. He studied Medicine at the University of Maryland School of Medicine, Baltimore, Maryland, and received the degree of Doctor of Medicine in 1935. Following graduation, he served a two-year rotating internship at the University Hospital, Baltimore, Maryland, followed by two years of residency training in the same institution.

He was appointed Assistant Surgeon with the rank of Lieutenant (junior grade) in the United States Naval Reserve on 15 June 1939, and was ordered to active duty, reporting 2 November 1940, to the Naval Hospital, Portsmouth, Virginia. Following professional examination, he was transferred to the Regular Navy with the date of rank of 2 November 1940, and through subsequent promotions advanced in grade to that of Rear Admiral to rank from 1 July 1965.

Following his first tour of duty at the Naval Hospital, Portsmouth, Virginia, he was ordered to the Naval Medical School, Washington, D.C., for an indoctrination course in August, 1941. Upon completion of this course, he was assigned to the Naval Hospital, Quantico, Virginia, and in December, 1941, was transferred to the Naval Air Station, San Juan, Puerto Rico. In July, 1943, he returned to the Continental limits of the United States and served in the Naval Dispensary, Washington, D.C.

In March, 1945, Admiral Albrittain returned to the Norfolk area as Medical Officer aboard the USS Wyoming. In December, 1946, he began three years of residency training in Dermatology at the Naval Hospital, St. Albans, New York, and the New York Skin and Cancer Unit of New York University Postgraduate Medical School. Upon completion of this period of instruction, he qualified as a Diplomate of the American Board of Dermatology and was assigned to the Naval Hospital, Long Beach, California, as the Dermatologist. Upon the closing of the Naval Hospital at Long Beach in June, 1950, he was transferred to the Naval Hospital, Portsmouth, Virginia, where he served as a Dermatologist, and later as the Chief of the Dermatology Service. In March of 1953, he was ordered as Medical Officer to the USS Iowa, and upon the completion of this tour of duty, he was assigned to the Naval Hospital, Bethesda, Maryland, as the Dermatologist.

In May, 1959, he reported to the Chief of the Bureau of Medicine and Surgery for duty as Head, Medical Corps Training. During his three-year tour in the Bureau, he also served as Head of the Training Branch, and later as Director of the Professional Division.

In June, 1963, Admiral Albrittain was assigned to the Naval Hospital, Portsmouth, Virginia, as the Executive Officer, and continued to serve in that capacity to 20 December 1964. On 8 January 1965, he assumed command of the Naval Hospital, St. Albans, New York, and on 9 June 1965, he was notified by the Secretary of the Navy of his selection to the grade of Rear Admiral in the Medical Corps. He was promoted on 1 July 1966, to rank from 1 July 1965. Admiral Albrittain assumed command of the Naval Hospital, and Naval Hospital Corps School, and District Medical Officer, Ninth Naval District, on 1 July 1966.

MEDICAL ARTICLES

TETANUS PROPHYLAXIS AND THERAPY

Neopito L. Robles, MD FACS, Benedict R. Walske, MD FACS,** and A. Rocco Tella, MD,*** Surg Clin N Amer 48(4):799–806, August 1968.*

Tetanus is a disease of man that could be almost completely eliminated by universal active immunization during infancy and childhood. There are approximately 200 cases of clinical tetanus reported yearly in the United States. There is, in all probability, a significant number not reported. The major roadblock is communication between the medical profession and the people regarding availability of an adequate immunization procedure within reach of everyone. The increasing use of the Diphtheria, Pertussis, Tetanus (DPT) series for our children by the pediatricians and the universal active immunization procedures instituted by the U.S. Armed Forces leave a tetanus prone population in most cases among women over 25 and men over 50 years of age.

No unimmunized person is safe from tetanus since the disease can develop with insignificant wounds, as reported by Altemeier and his group. Several factors are important in the overall appraisal of the incidence and the results of the treatment of tetanus; (*a*) age of patient, (*b*) length of incubation period, (*c*) nature of the wound, and (*d*) presence of concomitant debilitating or metabolic disease, such as diabetes.

This manuscript is a current review and appraisal of the progress of a more rational prophylactic and active treatment of tetanus. It is presented as a guideline for the surgeon in the management of patients with traumatic wounds and clinical tetanus and includes recommendations established by research and clinical experience.

Prophylactic Management of Tetanus

The incidence of trauma in our civilian population is constantly increasing and ranks fourth as the cause of death in the United States, being the most common cause in childhood. The threat of tetanus as a post-traumatic complication in this large group of patients warrants serious consideration. There are certain basic principles upon which sound prophylactic treatment of tetanus is based: (*a*) tetanus toxoid immunization prior to injury, (*b*) proper surgical management of wounds, (*c*) administration of antibiotics, and (*d*) human immune globulin administration.

Tetanus toxoid immunization is the simplest method and cheapest immunologic agent available. If universal active immunization with toxoid were possible, then clinical tetanus could be entirely prevented; however, there are legal impediments in achieving this goal. Fortunately, in the United States, most children and young adults have received immunization with DPT series during the past two decades. The men who have had military service have been fortunate in receiving tetanus toxoid at the time of induction and often later as periodic boosters.

Immunization with the DPT series is usually started between the second and sixth month of age. Three doses are given intramuscularly four weeks apart and a booster at 15 months of age. A booster dose is given at six years of age, usually when the child begins to attend school. The basic immunization with tetanus toxoid alone consists of three subcutaneous or intramuscular injections of 0.5 ml. of fluid toxoid or two injections of 0.5 ml. of alum-precipitated toxoid and a later reinforcing dose.

The length of time protective levels of tetanus antibodies are maintained after initial immunization is the subject of much discussion. Until recent years, it has been considered that protective levels of tetanus antibodies last only some five years. Studies by the authors and others have shown that booster doses of tetanus toxoid will recall high serum levels within seven days. In our series of 64 patients studied so far who have not received any booster for periods of 10 to 21 years, 61 percent have shown levels of at least 0.1 μ./ml. of blood prior to the booster dose. Titers were assayed seven days after the booster and all showed recall of antibodies within protective levels (0.1 μ. or more per millimeter of blood).

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As a result of these studies, we are strongly opposed to the use of equine antitoxin for patients previously immunized regardless of the time interval between initial immunization and the time of injury. The risk of reactions to equine antitoxin is too great for the benefit that could possibly be obtained since 0.5 ml. of toxoid given intramuscularly will recall the titers of antibodies to protective levels within seven days. In patients where there is an overwhelming possibility of tetanus, we recommend 400 μ. of Tetanus Immune Globulin given at the same time, but in a different site than the toxoid. Studies by Rubbo have shown that 400 μ. gives a longer protective level of tetanus antibodies than 250 μ. as suggested by others.

For those patients who have not received any previous active immunization, it is recommended that a series of toxoid injections be initiated and passive immunization with 400 to 500 μ. of tetanus immune globulin be administered at the time of injury (Fig. 3). Eckman feels that the combination of toxoid and antitoxin delays the booster response, yet most observers believe that this affords adequate protection.

Tetanus Prophylaxis Program

I. Previously immunized individuals:
   A. For Majority of Patients with Traumatic Wounds.
      (1) Tetanus Toxoid—0.5 cc.
   B. For Those with Wounds Which Indicate An Overwhelming Possibility of Tetanus.
      (1) Tetanus Toxoid—0.5 cc.
      (2) Human tetanus immune globulin—400 units.
      (3) Consider the use of penicillin or tetracycline.

Figure 3.

As part of the overall treatment of the patient, thorough surgical debridement of the wound is of the utmost importance. Removal of devitalized and severely injured tissues and foreign bodies are part of the local care of the wound. There seems to be universal agreement that thorough surgical debridement can convert a tetanus-prone wound into a clean wound, thereby preventing a potential infection with Clostridium tetani. Certain types of wounds, such as those caused by high velocity missiles in which a large area of necrotic tissue may be expected to develop around the path of the missiles, are best packed loosely with sterile dressing after debridement and then inspected frequently. We, like others, cannot overemphasize the importance of proper care and thorough debridement of the wound. In spite of this, a small number of cases of clinical tetanus have developed following small and relatively superficial wounds or even when a wound cannot be demonstrated.

The value of antibiotics in the prophylaxis of tetanus is still the subject of much discussion. To some their value is still questionable, but others are convinced that penicillin and oxytetracycline given promptly after injury are powerful deterrents of tetanus. Two reports from England indicate that no equine or bovine antitoxin prophylaxis was used in 130,000 traumatic cases. Massive doses of penicillin were given in these cases and no clinical tetanus developed. A convenient method of administering penicillin is to give 1.2 million units of long-acting benzathine penicillin G intramuscularly weekly for three weeks. Oxytetracycline is considered the best of the tetracycline analogues based on in-vitro sensitivity testing of Clostridium tetani strains. Oxytetracycline should be given in oral dosage of 1 to 2 grams a day for three weeks.

Active Treatment of Established Tetanus

The successful management of clinical tetanus depends upon early diagnosis and prompt and adequate treatment. With present-day intensive treatment the mortality rate has been reduced from approximately 60 percent to 20 percent. The prognosis is worse among patients of the older age groups and in patients having a short incubation period. Supportive and symptomatic treatment is designed primarily to prevent fatal complications usually respiratory in nature. Intensive nursing care is therefore an important facet in the treatment of such cases. Specific measures must also be intensive in nature.

An outline and discussion of therapeutic measures follow:

(*a*) Serotherapy. In the past, tetanus antitoxin (equine and bovine serum) has been used to neutralize the circulating tetanus toxin. Considerable discussion has been published concerning the effectiveness of serotherapy in established tetanus. Experiments in the animal laboratory have provided conflicting reports on the benefits obtained from tetanus antitoxin. Allergic reactions or delayed serum sickness and hepatitis have been reported following the use of equine or bovine serum and have been the main objections to their use.

If preliminary skin or eye sensitivity testing are negative, the following dosage schedule may be recommended.

1. Fifty thousand units of tetanus antitoxin intravenously

2. Forty thousand units of tetanus antitoxin intramuscularly

3. Five thousand units of tetanus antitoxin given intramuscularly every day until the disease is obviously under control

4. Infiltration of the tissue around the site of injury with 10,000 units of antitoxin one hour prior to excision of the wound.

Within the past several years hyperimmune human globulin has become available and has eliminated many of the objections to the therapeutic use of tetanus antitoxin. Several reports have shown good results with the use of hyperimmune human globulin and it appears to be as effective as equine or bovine serum antitoxin. Sustained high levels of circulating antitoxin have been obtained with doses of 3000 to 6000 units. Prolonged high levels up to 14 weeks were obtained after initial therapy with hyperimmune human globulin. There has been no sensitivity reported following intramuscular administration of the latter. The mortality rate remains about the same; however, the advantage is the absence of the danger of allergic reaction.

(*b*) Surgical Debridement of Wound. This is of more value in the prophylactic treatment of tetanus than in established tetanus. However, if the primary wound is still present, a preliminary infiltration of the area with hyperimmune globulin, equine, or bovine antisera one hour prior to extensive debridement is indicated. Care must be taken in instituting adequate sedation and proper anesthesia to prevent respiratory complications during and after the operative procedure.

(*c*) Sedation. An adequate amount of sedation can reduce the severity, frequency and duration of convulsive seizures. This probably is the most important part of the symptomatic treatment of established tetanus. The ultra-short acting barbiturates, such as Pentothal Sodium and Surital, are probably the most efficacious agents for general sedation of the patient. These are preferably administered in dilute solutions (1 gram per 1000 cc. of fluid) as a slow continuous intravenous drip. The rate of flow is adjusted to produce sleep, from which the patient can be aroused by moderate external stimuli. Should a severe convulsive seizure occur with respiratory arrest, several milliliters of a 2.5 percent solution of the barbiturate should be given intravenously immediately. Relaxation of the muscles usually follows within 45 to 60 seconds and permits re-establishment of the respiratory cycle. These solutions should be freshly prepared daily since they are relatively unstable. Close observation by an experienced anesthesiologist is important in patients in whom a satisfactory level of sedation may be a problem, as in those with cirrhosis of the liver, renal or pulmonary disease, or with drug addiction.

Chloral hydrate is another drug that has been employed for sedation. It may be administered by retention enemas in doses of 10 to 40 ml. every four hours as necessary. It may also be given by a feeding tube in doses of 1 to 5 ml. in milk.

(*d*) Tracheostomy. The performance of early tracheostomy in treating severe cases of tetanus using a cuffed endotracheal tube should be seriously considered. It facilitates better bronchial toilet and decreases the anatomic dead space. It is also very helpful in the use of mechanical ventilators for resuscitation of these patients. Tracheal aspiration should be done as indicated, and with aseptic precautions to prevent secondary tracheobronchial infections. Adequate humidity of the air mixture should be maintained to prevent dehydration of the respiratory epithelium. Tracheostomy has its own inherent dangers and complications and should be done only when indicated and with great attention to its after-care.

(*e*) Mechanical Respirators. There are a number of efficient intermittent positive pressure breathing apparatuses that may be very helpful in providing adequate ventilation for these patients, especially in the presence of heavy sedation. The decision to use a mechanical respirator should be individualized for each patient with established tetanus, and constant monitoring by nursing personnel familiar with the respirator is necessary at all times to prevent any further complication of its use. Volume type respirators are to be preferred.

(*f*) Intensive Nursing Care. Each patient with tetanus should be in constant attendance by a trained nurse or physician to administer adequate therapy. This is extremely important so that convulsive seizures and episodes of respiratory arrest can be immediately recognized and promptly treated. Periodic aspiration of the upper and lower respiratory tree should be accomplished to prevent atelectasis, aspiration pneumonitis, and asphyxia which are common complications in inadequately treated patients. The patient should never be left unattended, should be kept in a dark quiet room, and all forms of external stimulation kept to the barest minimum. All essential nursing care, such as turning patients, tracheal aspiration, and taking the temperature, should be done with utmost care.

(*g*) Fluids and Calories. The nutritional needs of patients with tetanus are high, and fluid, electrolytes, and caloric needs are best supplied by tube feeding. This is important to minimize negative nitrogen balance. Medications may also be given through the indwelling nasogastric tube. However, in the presence of ileus, it may be necessary to depend entirely on intravenous therapy.

(*h*) Antibiotics. Massive doses of penicillin or tetracycline are recommended for these patients although antibiotic therapy is of little value once clinical tetanus has become fully established. They are primarily utilized to prevent or control secondary infection of the wound or infections of the respiratory system.

(*i*) Hyperbaric Oxygen. There are reports in the literature of the use of hyperbaric oxygen as an adjunct to the overall management of tetanus. This form of therapy may be regarded as rational but is not frequently available because of the small number of centers where it is provided. Its actual value has not yet been well tested.

(*j*) Muscle Relaxants. There are reports indicating the use of muscle relaxants to control convulsive seizures in tetanus. However, the margin of safety with these drugs is narrow. Altemeier and his co-workers suggest that they be given only to those patients who are difficult to manage and only under the careful supervision of an experienced anesthesiologist.

Summary

Tetanus prophylaxis is the ideal solution to the large number of traumatic cases treated throughout the country. There are some 200 cases of tetanus reported yearly in this country and these attest to the need for an effective immunization program. Tetanus immunization is achieved with the use of fluid or alum-precipitated toxoid in adults and in children with DPT immunization series. In recent years, the dangers experienced in passive immunization with equine or bovine serum have been greatly reduced by the use of hyperimmune human globulin. The levels of antibody titer with the human globulin are more prolonged and predictable. In previously immunized individuals, regardless of the time interval between the initial immunization and the injury, a booster dose of 0.5 ml. of toxoid is sufficient to recall the antibody titers up to protective levels. In those with wounds that pose an overwhelming possibility of tetanus, 400 to 500 μ. of hyperimmune human globulin is given at the same time as the booster.

In established tetanus thorough surgical debridement, serotherapy, preferably with hyperimmune human globulin, adequate sedation, antibiotics, prevention and treatment of respiratory complication, and intensive nursing care are the mainstay of the treatment program. The use of hyperbaric oxygen is a rational treatment but not fully proved by the still limited experience of the few centers equipped with the hyperbaric tank.

Addendum

Individuals NOT Previously Immunized

A. For clean minor wounds in which tetanus is unlikely, start 0.5 cc of tetanus toxoid as an initial immunizing dose and complete the series of 3 doses at 4 week interval.

B. For all other wounds:

1. Start 0.5 cc toxoid as initial immunizing dose and complete series of 3 doses at 4 week interval.

2*. 250 μ of human tetanus immune globulin

3. Adequate surgical debridement

4. Consider the use of oxytetracycline or penicillin, if indicated.

*In severe neglected or old wounds, 500 units of human tetanus immune globulin are advisable.

(The omitted figures and references may be seen in the original article.)

BELL'S PALSY

A NEUROLOGICAL POINT OF VIEW

David A. Drachman, MD, Chicago, Arch Otolaryng 89(1):147–151, January 1969.

As the neurologist on the panel, I must begin by saying that cranial and peripheral neuropathies are among the most common disorders that we see. Neuropathies may be produced by lesions at the nuclear, radicular, or peripheral levels. The pattern of involvement may be that of an isolated mono-

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neuropathy, a mononeuropathy multiplex, or a symmetrical disal polyneuropathy. Neuropathy may be caused by heavy metal poisoning at one extreme or by simple mechanical compression at the other.

To evaluate any neuropathy, the neurologist must proceed in a systematic manner. He should first determine the location and extent of involvement of the nervous system. He must then try to identify the etiology and evaluate the prognosis. Only then can he formulate a rational treatment based on his conclusions.

"Bell's palsy" is the name given to a neuropathy involving the seventh cranial nerve. While Sir Charles Bell originally described facial paralysis due to gunshot wounds, tumors, syphilis and even goring by an ox, the term "Bell's palsy" has recently become restricted to mean a paralysis for which there is no local cause, or an idiopathic, isolated paralysis. Since "idiopathic" means of unidentifiable etiology, more and more identifiable conditions have been removed from the province of Bell's palsy. With few exceptions, it has been tacitly assumed that the remaining idiopathic cases are homogenous, due to a single etiology. Some of the suggested mechanisms have included viral inflammation, ischemia, compression, etc. On the basis of these mechanisms, various therapeutic regimens have been proposed, including stellate block, steroid therapy, surgical decompression, and others.

Unfortunately, there has been too little effort devoted to discovering the etiology of facial paralysis in every individual case; in the absence of obvious otitis or trauma, it is much too readily accepted as idiopathic. The neurologist's viewpoint is that in Bell's palsy the nervous system should be studied just as in paralysis involving any of the other cranial or spinal nerves. The lesion must be localized; the etiology sought systematically; the prognosis determined; and treatment based on the location, severity, and probable etiology of the neuropathy. As accurate diagnoses are established in more and more cases, we should see the number of "idiopathic" Bell's palsies dwindle.

Localization of the Lesion.—There are two operations involved in localization of the lesion: finding the extent of involvement of the nervous system and "pinpointing" the site of the lesion in the facial nerve.

In the tabular material below I have listed some of the neurologic pictures in which facial paralysis may be a prominent feature.

Neurological Pictures Including Facial Paralysis

Hemiplegia of cerebral origin
Pontine lesion (supranuclear, nuclear)
Cranial Neuropathy
Facial diplegia
Facial and peripheral mononeuritis multiplex
Polineuropathy with facial weakness
Isolated mononeuritis of facial nerve.

Of course, it is easy to distinguish a gross hemiplegia from a strictly isolated facial nerve paralysis; but many of the combined lesions can be detected only on careful neurologic examination. For example, slight loss of vibratory sensation in the toes can easily be missed in a patient with Bell's palsy, or a minimal abducens weakness may be overlooked. When we are satisfied that the facial paralysis is due to peripheral neuropathy of the seventh nerve, "pinpointing" of the lesion may be of value if an operation is to be considered. You are well aware of the work that has been done to perfect measurement of stapedial reflexes, nasolacrimal reflexes, salivary secretion, and taste sensation. It should be emphasized, however, that the idea of "pinpointing" the lesion must be regarded cautiously. Nerves are seldom disrupted completely at a tiny point along their course. More commonly, partial disruption over a considerable length of nerve is found. We must remember that incomplete seventh nerve lesions may masquerade as distal ones, particularly if visceral functions are preferentially spared.

Etiology of Facial Paralysis.—Facial paralysis may be produced by a large number of identifiable disorders, some of which are listed in the tabular material below. As long as this list is it is far from complete.

Etiology of Sudden Facial Paralysis

Central Lesions

Cerebrovascular accident (ischemic hemorrhagic)
Demyelinating disease
Pontine tumor
Poliomyelitis
Sylvian aqueduct syndrome

Peripheral Lesions: Intracranial

Infections	Autoimmune
Meningitis-acute, tuberculous	Guillain-Barré
Syphilis	Toxic-metabolic
Leprosy	Diabetes

- Varicella, rubella, mumps
- Infectious mononucleosis
- Herpes zoster
- Otitis media
- Osteomyelitis, petrositis

- Uremia
- Isoniazid
- Pregnancy

- Hereditary
- Familial
  - Recurrent neuropathy

- Tumors
  - Neurofibroma
  - Leukemia
  - Cholesteatoma
  - Metastatic tumor
- Melkerrsson's syndrome
- Trauma
  - Accidental
  - Surgical
- Granulomas
  - Wegener's granulomatosis
  - Sarcoidosis
  - Granulomatous meningitis
- Compression
  - Edema of nerve in canal
- Vasculitis
  - Polyarteritis
- Paget's disease
- High altitude

Peripheral Lesions: Extracranial

- Trauma
- Sarcoidosis
- Parotid tumor
- Compression (sleep)

Yet, consider that every patient with a facial paralysis due to one of these conditions does not have "idiopathic Bell's palsy." No one can say how often facial paralysis is due to the etiologies listed here; but, surely, most patients are not studied sufficiently to discover more than a few of these conditions. Just how large this problem may be is suggested by findings in several recent reports. Alter noted that almost 30 percent of patients with Bell's palsy had a close relative with the same condition. In addition, 25 percent of his patients were hypertensive and 5 percent developed Bell's palsy during pregnancy. In another study, at least 5 percent of patients with Bell's palsy were diabetic. Thus, in a major proportion of patients, "idiopathic" Bell's palsy may in fact be due to identifiable conditions.

Diagnostic Studies in Bell's Palsy.—The battery of studies performed in all cases should be adequate to identify at least the more common causes of facial paralysis (tabular material below).

Diagnostic Studies in Bell's Palsy

- Complete blood count (leukemia, viral or bacterial infection)
- Urinalysis (renal failure; diabetes)
- Chest x-ray (sarcoid; metastatic tumor)
- Glucose tolerance test (diabetes)
- Sedimentation rate (arteritis, infection)
- Skull x-rays with Stenvers' views (tumor, fracture, infection in petrous region)
- Lumbar puncture (meningitis; Guillain-Barré neuropathy; demyelinating disease, etc.)
- Viral titers
- Peripheral nerve conduction velocities (general neuropathy)
- Vestibular studies, audiometry (acoustic neuroma; petrous lesion)
- Pneumoencephalogram (pontine or cerebello-pontine angle tumor)

A detailed history of recent illnesses or infections, local trauma, familial incidence of Bell's palsy, and recurrence of facial or other paralyses should be obtained and a detailed neurological examination performed. In addition to routine laboratory studies, a sedimentation rate, glucose tolerance test, and a series of skull x-ray films with special petrous views should be obtained. A lumbar puncture is needed to determine the presence of a meningeal reaction, an albuminocytologic dissociation, or elevation of globulins. Peripheral nerve conduction velocities may be helpful in identifying an inapparent general neuropathy, as we have seen often in uremia, diabetes, and familial neuropathies. When a viral infection seems likely, appropriate serum antibody titers (herpes zoster, mumps, rubella, varicella, or heterophile) should be obtained. Occasionally a pneumoencephalogram may be needed to evaluate a possible pontine tumor.

Other Etiologic Considerations.—When all the diagnostic procedures have been completed, patients with facial paralysis fall into four classes: (1) those with central nervous system involvement; (2) those with local pathology; (3) those with a systemic disorder, with or without widespread peripheral neuropathy; and (4) those without any identifiable etiology.

The question is asked, "Why is the facial nerve so frequently the site of a neuropathy?" Even though other unexplained cranial neuropathies are common, it is worth considering what special features of the seventh nerve may predispose it to a mononeuropathy. There is, of course, no assurance that idiopathic Bell's palsy is due to any single cause. Re-

cently, however, most authors have directed their attention to the anatomic features of the facial nerve and its long, bony canal. Ischemia and secondary edema of the nerve within the canal have been suggested as the likely etiology of Bell's palsy and efforts at treatment have been aimed at these factors.

In neurology ischemic neuropathy is rare, occurring in only a few circumstances: proximal large-vessel occlusion, as seen in Leriche's syndrome, or multiple small-vessel disease, as seen in polyarteritis, and possibly in diabetes. Because of the rich anastomotic supply of vasa vasorum, ischemia of nerves is extraordinarily difficult to produce. Sunderland, for example, stripped peripheral nerves free of all entering vessels for 15 cm without any loss of function. Sunderland has also studied the blood supply of the facial nerve, and he has shown it to be much more extensive than was once thought. Overlap of blood supply from at least two sources—the stylomastoid and petrosal arteries—can be found at every point along the nerve within the facial canal. This makes facial nerve ischemia unlikely to occur on the basis of occlusion or spasm of a blood vessel. On the other hand, the possibility remains that facial nerve edema from some other cause could produce secondary compression and local damage within the facial canal. In this way, systemic disturbances of nerve function below threshold for the production of a clinical neuropathy in the limbs may result in a facial paralysis. This sequence of events is well known in diabetes and in certain hereditary neuropathies where compression palsies may develop quite readily in the presence of subclinical disturbance of nerve function.

This concept of the facial nerve as a *locus minoris resistentiae* may partially explain the occurrence of Bell's palsy, but there are still several puzzling questions: (1) the normal facial nerve occupies no more than 65 percent of the canal, and usually less than 50 percent, there would seem to be considerable room for some swelling without injury; (2) although we are primarily concerned with the limitations of the bony canal in causing nerve compression, the "bulging" of the nerve described at operation is from the nerve's own perineurial sheath rather than from the canal. Compressing a nerve within its own perineurium is unknown elsewhere in neurology. In the entrapment syndromes, compression is produced by bone, ligament, or cartilage. The whole phenomenon of "bulging" and its relation to edema of the nerve has been questioned by Sunderland and Collier who state that it occurs when the perineurium of a normal nerve is incised. Furthermore, Sade and his co-workers found no pathologic changes in the epineurium or perineurium of the facial nerve in Bell's palsy despite "bulging" at operation. All in all, the role of compression within the facial canal may be of importance in some cases and not in others. In any event, measurement of pressures within the Fallopian canal may help to settle the issue.

Prognosis.—Before considering any form of treatment, the prognosis must be determined in each case. Many recent studies of gustometry, chronaximetry, strength duration curves, electromyography, and nerve excitability have permitted earlier, more accurate estimates of the prognosis for recovery. In our laboratory we have found that loss of nerve excitability is the most reliable omen of an ultimately incomplete recovery. This may be seen as early as the fifth day following paralysis. Many patients with loss of nerve excitability will still, however, have acceptable cosmetic results.

Treatment.—Treatment of Bell's palsy is based on the etiology of the paralysis in each case. When trauma, infection, or tumor produce facial paralysis the treatment is clearly surgical. When pontine infarction or Guillain-Barré neuropathy is responsible, it is just as clear that the treatment is medical. When we are unable to determine the cause of the facial paralysis—idiopathic Bell's palsy—management becomes much more controversial. You are all aware of the many forms of therapy, both medical and surgical, that have been tried for Bell's palsy and that none has emerged as an invariable cure. Some of the treatments that have been tried are listed in below.

Methods of Treatment Used in Bell's Palsy

Local heat
Electrical stimulation-galvanic, faradic
Massage
Exercise
Stellate ganglion block
Steroids
Histamine
Procaine
Nicotinic acid
Papaverine
Dihydroergotamine
Neostigmine
Surgery

1. Decompression of facial nerve in canal
2. Anastomosis of facial nerve with other nerve
3. Excision and graft of segment of facial nerve

Essentially the controversy over the treatment of idiopathic Bell's palsy arises from the lack of a single adequately controlled study which shows any advantage for any method of treatment. Taverner's study of adrenocorticotrophic hormone (ACTH) almost reached statistical significance but failed when the initial protocol was abandoned.

There are many reasons why it has been difficult to establish the benefit of a single type of treatment. For example, Bell's palsy may be due to several mechanisms, some responding to one and some to another therapeutic regimen. Then, the spontaneous recovery rate of approximately 75 percent makes evaluation of any treatment difficult. The time at which treatment is begun can have an important influence on the outcome. Yet, to avoid treating those patients who will recover spontaneously, we have to wait for development of signs of denervation, at which time the nerve injury may no longer be reversible.

The status of surgical treatment of Bell's palsy remains at present an unsettled question for the neurologist. Disregarding the uncertainty of the theory on which the procedure of decompression is based, the treatment is painful, expensive, and not without hazard, at least in the hands of an inexperienced operator. Yet the attractiveness of relieving pressure on a trapped nerve captivates even the neurologist. If careful studies prove the value of the surgical approach, it may become our treatment of choice in selected cases.

In our neurologic clinic, management of Bell's palsy is first directed toward diagnosis of the underlying etiology. Secondly, the prognosis is estimated by means of electrical studies. All patients are directed to massage the facial muscles, protect the uncovered eye, and are given analgesics when necessary. Those with complete facial paralysis and a poor prognosis as determined by electromyography are given ACTH in a ten-day course. If facial paralysis remains disfiguring, without signs of recovery after three months, surgical intervention is then contemplated.

We feel that in 1967 this combines the most nearly proven medication—ACTH—with the physician's doctrine of *primum non nocere*—first do no harm.

(The references may be seen in the original article.)

MANAGEMENT OF HEAD INJURIES

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Classification

Head trauma may produce a localized or generalized injury. Localized injury is usually caused when a small object moving at moderate velocity strikes the head. It expends most of its force upon a small area of the scalp and skull and may even penetrate the skull, dura, and cortex without causing loss of consciousness. This type of injury requires early debridement with suturing of all scalp wounds and intradural debridement with dural repair when the bone is depressed and the dura torn. With generalized injuries the entire skull may become deformed so that it cracks, thereby compressing the underlying brain, or accelerating and decelerating forces may be set in motion within the brain and cause the surface of the brain to be contused against bony promontories of the skull, and result in avulsion of bridging veins. Generalized injury usually results in loss of consciousness. In many instances there may be features of both localized and generalized injury.

Loss of consciousness has, by frequent association, become the index of severity of intracranial disturbance following injury. While an absolute relationship does not exist, unconsciousness remains the most useful sign of intracranial dysfunction. For this reason the state of consciousness has been used as the primary basis for classification of most of the material to be presented. In general, head-injured patients may be classified as follows:

1. Unconscious when first examined and dating immediately from the injury:
   a. Extensive laceration and bruising of the brain with rapid deterioration and death; these patients are beyond present techniques of medical help.

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b. Moderately severe intracranial injury requiring extensive, and sometimes prolonged, medical and nursing care; these patients constitute the majority of individuals with whom the following remarks are concerned.

2. Alert when first examined but previously unconscious
3. Delayed alteration of consciousness; usually due to intracranial hematoma; may have experienced brief loss of consciousness after injury
4. Never unconscious

In addition to the categories listed above there is a group of patients whose management is based primarily on factors only indirectly related to the effect of mechanical impact on the brain. Included in this group of patients are those with basal fractures who are candidates for ascending infection, and those having depressed fractures whose basis for treatment does not concern disturbance of brain function.

Clinical Management

Although degrees of unconsciousness have never been satisfactorily classified and defined, it must be clearly appreciated that the term unconsciousness covers a broad spectrum of disturbances varying from mild lethargy or confusion to profound coma without response to external stimuli. For present purposes no sharp distinction is being made between variations within this spectrum. Thus, any patient who, as a result of cerebral trauma, does not respond appropriately to his environment, including verbal stimuli, is considered to be *unconscious*. As will be noted, there are variations in management which are related to the severity of altered consciousness.

1. The Unconscious Patient

Initial Management

Immediately and sequentially the unconscious patient needs:

1. Maintenance of the Airway. This is of utmost importance because anoxia and excess carbon dioxide produce brain swelling and many patients thought to be moribund improve dramatically when good aeration is secured. The tongue of the comatose patient in a supine position must be regarded as a foreign body in the oropharynx. Oropharyngeal secretions, vomitus, blood, and cerebrospinal fluid leaking from a basal skull fracture may add to the obstruction. Extension of the head and elevation of the jaw will raise the tongue out of the posterior oropharynx. Secretions are removed by nasopharyngeal and oral suction. If the patient is deeply comatose an oral or nasopharyngeal airway should be inserted. If this is insufficient an endotracheal airway is needed. If the coma is light, the use of a suction tube or indwelling airway in the oral pharynx may stimulate vomiting and add to the obstruction. An endotracheal tube may produce distressing cough. In such cases tubes are not used and the patient is turned to the three-quarter prone position to enable the secretions to drain by gravity while the jaw and tongue fall forward away from the posterior pharyngeal wall. If ventilation is not adequate after the above measures, as indicated by stridor, chest retraction on inspiration, or the relatively late sign of cyanosis, tracheostomy should be done without delay. Mechanical assistance of respiration may also be used if the central respiratory driving mechanisms have been sufficiently injured or if there is an associated chest injury which decreases the effectiveness of respiratory effort.

2. Evaluation and Control of Blood Pressure. Since brain injury alone rarely causes loss of vasomotor tone, the presence of shock indicates extensive body injury to some part other than the head. The most common sites of blood loss leading to oligemic shock are intraperitoneally, retroperitoneally, intrathoracically, into soft tissues adjacent to a fractured long bone, and, more rarely, from scalp laceration. Only in infants can sufficient blood loss occur intracranially to lead to oligemic shock.

Oligemic shock, when severe, may cause loss of consciousness because of insufficient blood supply to the brain. This condition is distinguished from blood pressure failure in the late stage of brain injury by the relatively light coma level in the presence of a very low blood pressure, by the fast pulse, sweaty skin and rapid, deep but regular "air hunger" respirations. Hypotension resulting from central vasomotor failure due to brain stem injury occurs usually as a terminal event and in the presence of profound coma.

If oligemic shock is present its treatment usually takes precedence over specific management of the head injury. Immediate replacement of blood volume by plasma and quick replacement of whole blood transfusion are required together with control of the source of hemorrhage, for example, removal of a ruptured spleen. Although a general anesthetic may raise the intracranial pressure unless very expertly administered and will mask the development of neurological signs, it is best to proceed expeditiously to control severe hemorrhage and accept the

possible risks to the central nervous system. Spinal anesthesia allows continuous observation of the effects of brain injury but tends to increase the degree of shock by relaxing vasomotor tone.

Low blood pressure is sometimes present without loss of blood. Fracture of the cervical spine with cord compression and interruption of sympathetic fibers may allow blood to pool in the dependent part of the body. Pain due to a fracture sometimes causes reflex lowering of the blood pressure but in this situation the pulse is not accelerated as it is in oligemic shock. As indicated previously, blood pressure failure may also occur as a manifestation of severe, and usually fatal, damage to the brain stem.

If the head-injured patient is not in shock there is no need at this stage to insert intravenous needles and catheters for the purpose of administering fluids. These only immobilize the limbs and interfere with an accurate determinaton of the neurological status. In all patients, whether shock is present or not, a systematic examination is made of the limbs, thoracic cage and spine by inspection and gentle palpation to determine the presence or absence of fractures. Early recognition and splinting of long bone fractures is necessary not only to prevent increasing the local trauma during uncontrolled movements of the irrational patient but also to minimize the possibility of fat embolization which may compound the brain damage.

3. Examination of the Head. Systematic examination of the external surface of the head may reveal lacerations and hematomas of the scalp. Hematomas are usually circular or oval and may have an elevated thickened edge. The fluctuant and depressable center is easily mistaken for a depressed fracture of the underlying bone. Palpation through the intact scalp is a notoriously unreliable means of distinguishing depressed fractures. They may be visible or palpable through an open wound but, as a rule, the most accurate means of diagnosis is by radiography.

While hematomas and contusions of the scalp require no specific management, depressed fractures may require immediate debridement, if compound, with either emergency or elective elevation. A most important scalp swelling is one that is found in the temporal region since this may indicate the presence of an underlying external hematoma. The swelling is due to direct contusion of the temporal muscle and to hemorrhage through the fracture site beneath the muscle. It gives swelling that has a soft boggy feeling and which does not pit on pressure. A soft swelling of the scalp which pits on pressure is due to local injury in the skin. Both may be present in the same area.

Subconjunctival hemorrhages accompanied by periorbital ecchymosis suggest a fracture of the anterior fossa. Persistent bleeding or loss of cerebrospinal fluid from the nose or ears indicates fracture of the base of the skull. Skin discoloration behind the ears (Battle's sign), which may not be obvious at an early stage, indicates fracture of the temporal bone. The significance of early recognition of basal fracture lies in the need for proper antibiotic coverage to prevent intracranial infection. This will be dealt with later.

In almost all cases hemorrhage from the scalp wound will have ceased by the time the general examination is completed. If an arterial spurter continues, this can be controlled by compressing the section of scalp involved against the underlying bone by the palmar aspects of the terminal digits of several closely approximate fingers. If a depressed fracture is suspected, pressure must be exerted at a distance from the wound. Pressure is continued for a minimum of five minutes. Hemostasis may also be achieved by everting the scalp edge by means of a hemostat applied to the galea. One must not probe blindly into the center of a wound with an artery forcepts as this may only start more hemorrhage. In addition, the brain may be damaged if a cranial defect due to depressed fracture is present.

4. Neurologic Examination. A complete neurologic appraisal is, of course, not possible in the presence of coma. Nevertheless, there are many signs which are not dependent on conscious cooperation by the patient but which contribute valuable knowledge of the status of the central nervous system. In addition to the external signs of trauma about the head, as discussed previously, the examiner must note the size, symmetry, and reaction of the pupils, the existence of spontaneous conjugate eye movements or movements in response to passive head turning (doll's eye movement), and the appearance of the ocular fundi as a basis for future comparison. The presence or absence of nuchal rigidity is to be determined. Symmetry of facial and limb movement, either spontaneously initiated or resulting from painful stimuli must be assessed and reflex activity, normal and pathological, must be noted and recorded.

In recent years echoencephalography has provided a convenient and rapid method of determining the midline of the brain. This, if available, should be used in the initial evaluation of all comatose patients

following trauma and serially thereafter if there is evidence of deterioration.

Vital signs consist of temperature, pulse and respiratory rates, and blood pressure. Traditionally much reliance has been placed on these signs as indices of increasing intracranial pressure, although in fact changes in these functions usually occur rather late in the course of progressive brain compression. Thus, there is fallacy in utilizing nursing time and effort on needlessly frequent and continued recording of vital signs. In general, these signs are of greater help in evaluating associated bodily injury which might lead to respiratory distress or to shock. The matter of hyperpyrexia will be considered later.

The most important single aspect to be appraised in the initial neurologic examination is the state of consciousness. As stated earlier, there is no method of classification which is universally accepted, partly because of the unlimited variations of manifestations which result from combinations of injuries to multiple interacting portions of the brain. For present purposes the term coma is used to indicate that the patient makes no response to the spoken word in distinction from the lighter states of impaired consciousness. For practical purposes one may distinguish four principal degrees of coma: light coma, deep coma, the premoribund state, and the moribund state.

Light Coma. The patient moves spontaneously and on noxious stimulation. The motor activity consists of purposeful, coordinated, and usually protective movements. Ideally the same area should be stimulated with the same intensity at each examination in order to estimate improvement of deterioration. The ulnar border of the hand and the sole of the foot are convenient. Comparison of movements on the two sides permits evaluation of mild degrees of paresis. Disproportionate absence of movement in the lower extremities in comparison with the arms raises the possibility of spinal cord injury. Increased movement on serial examination usually means that that patient is awakening. Rarely, however, increased spontaneous movements, especially rubbing the head indicate that the patient is actually deteriorating, and that in fact he is experiencing head pain due to an accumulating intracranial hematoma. While the patient remains in light coma, there is no alteration in the pulse or respiration.

Deep Coma. Spontaneous and evoked movements decrease and become less purposeful and coordinated, consisting mainly of withdrawal motions. The pulse rate slows and subtle changes occur in the rate and lepth of respiration. These are very serious signs. If present immediately after injury they indicate severe neural disruption occurred at the time of the initial impact. If, however, there is progression from light to deep coma while under observation, it must be concluded that either hemorrhage or cerebral swelling is occurring and appropriate diagnostic and therapeutic measures must be taken.

The Premoribund State. Spontaneous movements have practically ceased and evoked movements are sluggish and feeble. The rate and depth of respiration continue to increase. The patient's trachea seems to be drawn down into his chest with each respiration (the ominous *tracheal tug*). Respiratory rhythm becomes irregular with fast and deep periods alternating with slow and shallow periods (Cheyne-Stokes respiration). The pupils constrict and may become unequal in size. Blood pressure commences to rise. Secretions in the pharynx become a problem causing the well known death-rattle.

The Moribund State. There is no response to painful stimulation. The pupils are fixed and dilated. There are periods of apnea at the end of each slow cycle. The pulse accelerates and the blood pressure begins to fall and may remain, for a time, at a level well below the normal systolic. Respirations deteriorate into inspiratory gasps, and respirations finally cease while heart function persists.

5. Differential Diagnosis. It is advisable at this point to recall that, while a combination of coma and external signs of injury usually indicate that head injury is the primary event, this is not invariably so. The comatose states of epilepsy and drunkenness are often associated with external signs of injury. Patients may sustain external injury if they suffer sudden collapse due to a coronary thrombosis, intracranial hemorrhage or a syncopal episode. The epileptic patient usually awakens within a few minutes and can be aroused even though he may appear drowsy for 30 minutes or more. The intoxicated person may present more difficulty in differential diagnosis because he awakens more slowly, but in his case, improvement is also continuous. Other types of coma independent of head injury must be considered on the basis of the history available.

Traumatic shock as a cause of coma has already been discussed. It produces a relatively light and restless coma with ashen pallor, cold clammy skin, and a deep sighing respiration as well as a fast pulse and low blood pressure. Fat embolism associated with a recent injury to bone or fatty tissue is likely to produce this type of coma although no primary head injury has been sustained.

Management During the First Few Hours After Injury

This stage is somewhat artificially separated from the first day to emphasize the fact that all patients who are very rapidly deteriorating from head injury need not be rushed off to the operating theater for the insertion of unnecessary burr holes. Unless there is a reliable history of a lucid interval or unless the nature of the trauma was disproportionately slight considering the depth of present coma, an extradural hematoma is unlikely. Rapid deterioration in the very early hours of a head injury is more likely to be due to extensive cerebral laceration than to an extradural or an acute subdural hematoma. For these rapidly deteriorating patients there is little to be done. A good airway must be maintained. Hypertonic agents (urea or mannitol) and steroids (hydrocortisone) are of questionable value in this type of situation but may be used. Surgery has nothing beneficial to offer.

For the less seriously injured, this first few hours after injury are a period of frequent and detailed observation during which the dynamic situation is carefully assessed for evidence of improvement or of worsening, and during which preparation is made for an extended period of very intensive care. The steps to be taken during this period are:

1. Maintenance of the Airway. The initial steps were reviewed earlier. The airway is maintained by turning the patient into the three-quarter prone position. The "upper arm" and leg are supported by means of a pillow or pillows. The head is turned to the side and secretions may drain from the mouth. Some extension of the head is advisable. The patient is turned at least every two hours simply by removing the supporting pillows and allowing him to fall to a prone posture, turning his head to the opposite side, and raising the opposite arm and leg upon pillows. The few patients who do not maintain a good airway in the three-quarter prone position may require tracheostomy. Repeated emphasis must be given to the necessity for resisting the temptation of well-intentioned nurses to elevate the head. This is usually done because the patient seemingly appears more comfortable and also because of a traditional but unfounded concept of preventing or reducing cerebral edema. As a matter of fact, this posture serves only to promote the development of pulmonary complications.

2. Restlessness is managed by padding the sides of the bed and by covering the hands with a soft bandage or padded boxing gloves so as to prevent the patient from grasping objects such as his catheter, intravenous apparatus, or the sides of the bed. Mild sedative drugs such as paraldehyde may be used if necessary.

3. Catheter. During the first few hours avoidance of bladder distension is very important and it is usually wise to insert an indwelling catheter into the bladder without delay. If any question arises in the history concerning pre-existing renal disease, quick estimation of kidney function should be made, anticipating possible use of the cerebral dehydrating agents, urea and mannitol. A blood urea or nonprotein nitrogen determination will suffice.

4. Medication. *Antibiotics.* Patients with evidence of a fracture at the base of the skull leaking cerebrospinal fluid and blood into the nasopharynx or into the middle ear, should be given an antibiotic in order to prevent intracranial infection.

Since gram-negative infections are extremely rare under these circumstances, penicillin preparations are generally used. Since this agent does not reach the cerebrospinal fluid in therapeutic levels, however, there has arisen some question about the validity of prophylactic use of the drug. Until this can be settled, most clinics are continuing its use.

Elderly patients and those who have aspirated vomitus should be given an antibiotic to prevent pneumonia. When a catheter is inserted it is common practice to routinely administer an antibiotic such as gantrasin to help prevent urinary infection.

Anticonvulsants. During the stage of coma a single convulsion could jeopardize a patient's life because of the short period of anoxia and of excessive carbon dioxide build-up which occurs. Both of these factors can cause acute swelling of the brain. For this reason, it is often advisable to administer prophylactic anticonvulsant medication such as dilantin.

Hypertonic Agents. While the indications for the use of these agents in traumatic cerebral disease are not well defined they should be considered when excessive cerebral swelling is suspected. The most commonly used agents at present are 30 percent urea and 20 percent mannitol solutions. Urea is administered in doses of approximately 1 gram/kg. body weight while mannitol is used in doses of about 2 gram/kg.

Steroids. The use of glucocorticoids is based on the knowledge that they reduce certain types of cerebral swelling, although the exact indication for and value of their use after head injury are not well delineated. It is usually given in the form of dexamethasone, 10 mg. initially and 4 mg. every four hours thereafter for several days.

5. Hyperpyrexia. Hyperpyrexia is a serious complication as it increases the metabolic requirements of a brain unable to cope with normal metabolism. Patients should be kept at a normal temperature by means of a cooling mattress or a cold tent. Hypothermia to levels of 28-30° C. used extensively over the last 15 years, does not seem to have provided much specific help and is now largely being abandoned in the management of head injury.

6. Serial Neurological Examination. The frequency depends upon the evidence of rapid change in the neurologic state and ideally one experienced observer should be in continuous attendance. Observations at least every 15 minutes must be regarded as a minimum during the first few hours.

7. X-ray Examination of the Skull. This should be done early in the patient's management if a depressed fracture is suspected or if there is evidence of injury in the temporal region. In the latter instance a fracture crossing the middle meningeal channel will raise the index of suspicion concerning an extradural hemorrhage. With these exceptions, however, it is considered that emergency roentgenographic examination does not contribute to the patient's better management and should be done later when optimum conditions exist for adequate examination. The size of the fracture by x-ray is not a good measure of the severity of the head injury.

8. Definitive Suture of Scalp Wounds. This may be attended to at any convenient time. The technique requires application of sound basic surgical principles of asepsis, debridement, and cosmetic repair.

Management During the First Day

This is a period of maximum suspicion of epidural hemorrhage though it may be present at any time during the first few days or even during the first few weeks. Often the patient has not been admitted until several hours have elapsed and valuable observations of the early hours are missing. If the history, examination and x-ray appearance are those of a severe crushing injury or through-and-through gunshot injury, it is probable that any deterioration that occurs is due mainly to laceration of the brain. If, however, the evidence indicates a lesser degree of injury, subsequent deterioration must be regarded as possibly due to an epidural or acute subdural hematoma. Laceration of the brain and meningeal hematomas may, of course, occur together.

The classical epidural hematoma presents with a history of initial and brief loss of contact following injury, followed by a lucid interval and later by progressive intracranial decompensation. Decline of the state of awareness from a condition of alertness to one of mild confusion, or to coma of progressively deteriorating degree is strongly suggestive of meningeal hemorrhage. If epidural bleeding is suspected by the clinical progression and the presence of temporal fracture of swelling, immediate surgical investigation is usually indicated without wasting precious time in the performance of arteriographic examination. If, however, such a classical sequence of events is not encountered, but progressive neural dysfunction is occurring, arteriography constitutes the best method of distinguishing between surface hemorrhage and cerebral swelling. Echoencephalographic determination of the position of midline structures is also of confirmatory value if a change from the initial observations has occurred.

If surgery or diagnostic evaluation are delayed during the period of deterioration, the patient should be given hypertonic solution intravenously in an attempt to prevent neural herniation and decompensation. These agents simply dehydrate the normal brain and result in a transient internal decompression. Apparent neurologic improvement after use of osmotic agents should not permit further delay in definitive surgical therapy through a false sense of security.

Children may show sudden and profound deterioration of level of consciousness at an early stage and may reach a state of fixed dilated pupils with one or more attacks of decerebrate rigidity and yet recover spontaneously. Sometimes they do this quite promptly and sometimes more slowly. Such an acute deterioration may be due to swelling or to an intracranial hematoma, but in all instances when the dilemma exists, it must be settled by arteriography and burr holes rather than by speculation. Not infrequently, before the preparations for these procedures can be completed, there will have been a perceptible improvement.

Fluid and electrolyte requirements during the first day are based on the knowledge of a tendency to salt and water retention during this interval. Because of water retention it is inadvisable to give an excessive volume of fluid. The recommended volume to be administered by infusion in the average adult should not exceed 2000 cc. daily. This should include sodium chloride in the amount of 4.5 grams (500 cc. 0.9 percent sodium chloride) which will help to prevent hypotonicity of body fluids and resulting cerebral swelling. The concept previously held that administration of sodium chloride tends to aggravate edema is now recognized as being inaccurate. In fact, withholding of salt may be definitely harmful.

Management During the First Week

If the patient has not shown signs of regaining consciousness within 24 hours, he may remain unconscious for several days or even weeks. The main problem under such circumstances is the management of cerebral swelling. Nevertheless, deterioration due to a late epidural or a subacute subdural hematoma can occur and must be watched for. Epidural hematoma in the anterior and posterior fossae characteristically present later than those occurring in the temporal fossa in immediate relation to the middle meningeal vessel.

1. Maintenance of the Airway. It is difficult to maintain a good natural airway over a prolonged period in most patients. Continued nasopharyngeal and oral suction traumatizes the oral pharynx with swelling and hemorrhage and this increases obstruction. In most instances it is advisable, therefore, to perform a tracheostomy if there are no signs of an early awakening. It is essential, however, that proper moistening of the air be provided as there is a strong drying effect of the mucosal and alveolar surfaces of the trachea and bronchii by prolonged administration of air and/or oxygen through a tracheostomy tube.

2. Position. The patient should be nursed, if possible, on an intermittent pressure mattress. He is turned from side to side at least every two hours in order to help empty secretions from the lungs. Again it is emphasized that the head should not be elevated.

3. Fluids and Nutritional Support. During the first three or four days intravenous fluid should be continued according to the amounts recommended during the first day. Sodium chloride should be administered each day to prevent hypotonicity unless there is some other contraindication such as cardiac decompensation. If hyperpyrexia exists or if there are other extrarenal losses of fluids the total amount given daily should be appropriately altered. Although neurogenic abnormalities of salt and water metabolism are rare it is advisable to determine serum Na, Cl, and K on the third day if the patient remains unconscious.

The average individual can tolerate lack of nitrogen intake admirably for several days and, indeed, there is poor utilization of nitrogenous food administered during that interval. Since such nitrogenous material can only be administered through a gastric feeding tube, it is recommended that this be delayed until the fourth day, or later if vomiting is occurring. When feeding is started through a tube, protein should be given in amounts not to exceed 1.0 gm. per kg. body weight per day. Amounts larger than this will lead only to excessive water excretion and diuresis.

4. Medication. Antibiotics and anticonvulsants are continued if it is felt they are indicated. Steroids may be discontinued after four or five days if the patient's condition has stabilized.

5. Treatment of Cerebral Edema. Swelling of the brain is often at its maximum by the third or fourth day. Several specific techniques are available to prevent, minimize, or treat this swelling. The use of steroids has been mentioned and may be continued as long as necessary, although discontinuation must be gradual if they are used for longer than six days. Hypertonic agents, also previously mentioned, seem to have little place in long-term control of swelling and hence are not useful. Hypothermia appears to delay but not prevent cerebral edema. The single most effective measure is maintenance of adequate ventilatory function to prevent build-up of CO_2 with its potent vasodilatory effect. Finally, surgical decompressive measures may be necessary if medical techniques are not effectual.

6. Serial Neurological Examination. These are continued in order to detect late epidural hematomas and subacute subdural hematomas. Again observations should ideally be continuous. The frequency of serial detailed examinations depends on the initial severity of the brain injury and the evidence of a changing status. The differentiation of hematomas from swelling is especially difficult. A period of improvement or the development of lateralizing paralysis is usually in favor of the presence of a clot rather than of swelling, but both can be present in cases of swelling, which in some instances, may be maximum in a localized area. The area most frequently involved is the temporal lobe. If hematoma or uncontrolled swelling is detected in the presence of neurologic deterioration expeditious evacuation of the hematoma or temporal lobectomy should be undertaken.

Management During Subsequent Weeks

By this stage problems of the airway have usually stabilized. Nutrition must be provided and this is best done by intragastric feeding. Excessive protein input is to be avoided since gradual dehydration and hyperelectrolytemia may be produced.

Most of the urgent hazards of intracranial decompensation have subsided although occasional subacute subdural, or more rarely epidural, hematomas will be recognized after the first week. Thus, repeated neurologic evaluation is still necessary to

detect indications of late deterioration.

In general, however, this period is devoted to supportive and nursing care while the patient makes gradual recovery from his neurologic deficit.

2. The Alert Patient Who Has Previously Been Unconscious

Even a short period of unconsciousness indicates that a brain injury of at least moderate severity has been sustained and that there is a possibility of developing a meningeal or intracerebral hematoma. Roentgenograms of the skull should be obtained in all cases. If there is a fracture line along the middle meningeal artery or across a major dural sinus, it is essential that the patient be observed closely, preferably in the hospital, for 24 hours. Observation consists of watching for increasing lethargy, changes in pupillary size or symmetry, paresis of motor activity in the extremities on one side, or convulsive activity. If no fracture is present an exceptionally alert family may elect to assume responsibility for this 24-hour period of observation with the understanding that the patient does not sleep for intervals greater than 30 minutes during the first four hours, one hour during the next four hours, and two hours during the remainder of the 24-hour period. The patient should be returned to the hospital if evidence of drowsiness, confusion, or increasing headache are noted by the relatives. A cardinal principle should be: if in any doubt admit to hospital.

The occurrence of lethargy after a period of alertness must arouse suspicion of intracranial bleeding, but by itself is probably not sufficient indication for carotid angiography. This is particularly true in young children who quite commonly become drowsy, pale, and confused as a delayed response following concussion. If lateralization of neurologic signs occurs, echoencephalogram and angiography are definitely indicated to determine if midline shift is occurring and if it is due to hematoma accumulation or to focal swelling.

3. Late Coma in a Patient Who Has Had Antecedent Head Injury

A disturbance of consciousness occurring weeks, or several months, after injury almost invariably indicates the presence of a subdural hematoma if the two events are related. The previous head injury may have produced a period of unconsciousness or no unconsciousness at all or, indeed, it may have been totally unremembered. There may be a history of deteriorating mental function, drowsiness, or headache, or any combination of these. Papilledema is rare, especially in the aged. There may or may not be lateralizing neurological signs.

Delayed coma following injury must be differentiated from the numerous causes of coma unrelated to injury. These include acute poisoning, (commonly barbiturate or carbon monoxide), acute encephalitis, meningitis, abscess, acute intracerebral hemorrhage, acute subarachnoid hemmorhage, and acute decompensation of a brain tumor. Diabetic, hepatic and uremic comas are usually accompanied by an adequate antecedent history. A coma of barbiturate poisoning is a very quiet one, like an exaggeration of normal sleep, with a slow depressed respiration quite unlike the irregular distressed respiration of brain stem decompensation. A diagnosis of carbon monoxide poisoning depends largely upon the history and the bright red complexion. Nuchal rigidity occurs with subarachnoid bleedings and meningeal infections as well as with fractures of the cervical spine, and also may occur in the late stages of brain stem impaction due to whatever cause. Lumbar puncture may be necessary to distinguish between subarachnoid hemorrhage and infection.

In all of those patients in whom a definite diagnosis of the cause of coma cannot be made, subdural hematoma must be suspected. Skull roentgenograms may indicate the presence of a midline or a displaced pineal gland while echoencephalography is of value for the same purpose if there is no pineal calcification. Angiography in a stage of deep coma and burr holes in the premoribund state will establish the diagnosis.

In infants and young children there is usually no history of head injury and frequently there is no skull fracture. Listlessness, anorexia, vomiting, anemia, and seizure are common. A seizure may precipitate coma. Again the numerous other causes of coma must be considered such as ingestion of aspirin or toxic agents, meningitis, encephalitis, metabolic disturbances, etc. Before the age of two years, the presence of retinal hemorrhages without elevation of the optic discs is highly indicative of subdural hemorrhage. Before the anterior fontanel closes, diagnosis and emergency treatment are easily made by a subdural tap. A short 22-caliber needle is inserted obliquely beneath the dura at the external angle of each fontanel. If subdural fluid is present, it will flow out freely. Not more than 30 cc. should be removed on the first occasion, but subsequent repeated taps are usually necessary to permit gradual accumulation and reexpansion of the under-

lying brain. Any infant harboring a subdural hematoma should have further x-ray evaluation of long bones and ribs to detect evidence of multiple injuries and possibly a "battered child" syndrome.

4. The Patient Who Has Never Been Unconscious

The majority of such patients require simple reassurance. X-ray examination is not necessary unless there is a scalp laceration and a depressed fracture is suspected. It may be noted, however, that depressed fracture may be present in an infant, and very rarely in an adult, without scalp laceration. Patients without fracture usually do not require hospitalization. The most frequent exception is the young child who has persistent vomiting after a relatively mild injury and is hospitalized to ensure against dehydration. Those who return home are assured that a small amount of headache and lack of energy are not unusual after a mild head injury and that these symptoms may last for a few days or a few weeks. They are advised that if headache becomes severe and is not relieved by simple analgesics, they should return for examination. Patients with unusually severe postconcussion headaches must be suspected of harboring a chronic subdural hematoma. In most instances the headache subsides in several weeks. A few individuals, motivated by factors of secondary gain or fearing loss of mental function, develop functional headaches. The cause of postconcussional headaches, dizziness, and loss of memory often may not be understood.

Summary

The general principles of management of patients who have sustained head injury are presented. Such patients are classified according to the existence, duration, and time of onset of disturbed consciousness. While no hard and fast rules can be outlined concerning these categories, the group requiring the most concentrated effort and skill consists of those in whom loss of consciousness persists for several days from the moment of injury. This group is dealt with in some detail, outlining the proper management when first seen, during the first 24 hours, during the first week and thereafter. It is emphasized that the major care of such individuals is of a supportive nature, with particular attention to maintenance of ventilatory function, combined with observation for and prompt surgical treatment of intracranial bleeding or cerebral swelling.

(The references may be seen in the original article.)

WATER INTOXICATION: ITS DIAGNOSIS AND MANAGEMENT

COL Edwin L. Overholt, MC USA, Milit Med 133(8):607–613, August 1968.*

Hyponatremia without edema but with adequate circulation may be seen with a relative or absolute excess of antidiuretic hormone (ADH). Symptoms and signs of water intoxication may intervene. This hormone is formed in the supraoptic and paraventricular nuclei of the hypothalamus and is stored in the posterior lobe of the pituitary. Stimuli and inhibitors probably act directly on these nuclei, releasing impulses via their axons which terminate as bulbous enlargements adherent to the walls of capillaries of the posterior lobe. When effective osmotic pressure is reduced by one percent, the resulting expansion of intracellular fluid inhibits release of ADH. Neural hypophyseal cells share the cellular overhydration, and this serves as an inhibitor of ADH release. It is also likely that osmoreceptors are present in the pulmonary venous circulatory bed and left atrium.

Normal adult posterior pituitary gland contains approximately 15 units of vasopressin. As little as 0.3 milliunits per kilogram of body weight per hour will elicit a normal antidiuretic effect. Larger amounts will only prolong this effect. The major sites of degradation of ADH are liver and kidneys which inactivate 50 percent of vasopressin present in blood circulating through each. Because of this large capacity, no disease state has been demonstrated as a result of impaired inactivation. Thus, clinical syndromes associated with excessive water retention result from excess ADH secretion.

Antidiuretic hormone alters permeability of distal convoluted tubule and collecting ducts of the nephron, thereby permitting diffusion of water along established concentration gradients into the hyper-

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osmolar interstitial renal fluid. Daily administration to volunteers is followed by an abrupt rise in urinary concentration, fall in urine volume, gain in body weight, and dilution of serum sodium and total solute concentration because of retention of water. Following three days of vasopressin administration, there is a striking sodium diuresis in spite of severe hyponatremia. However, this over expansion of extracellular fluid volume does not sufficiently increase glomerular filtration rate or decrease aldosterone output to account for sodium diuresis. More important is the suppression of proximal tubular reabsorption of sodium in response to expansion of extracellular-fluid volume ("third factor effect"). Urine remains hypertonic despite hypotonic plasma. Concomitant water diuresis is prevented by the exogenous vasopressin. Gross edema does not occur in spite of water retention, because much of the water is intracellular. Moreover, retention of three to four liters of fluid in the extracellular space is not likely to produce edema. Continued administration of vasopressin produces a steady state in which hyponatremia persists, but water and sodium balances are re-established. Urine volume and sodium excretion will reflect intake of water and sodium as in the normal individual. However, if there is a further acute expansion of body fluid, sodium diuresis will recur. When vasopressin is discontinued, water diuresis occurs and sodium retention follows until the sodium deficit is corrected.

The clinical counterpart of chronic pitressin administration was first recognized by Schwartz and associates in two patients with undifferentiated bronchogenic carcinoma. These investigators emphasized that continued antidiuretic state in the presence of serum hypotonicity with normal renal and adrenal function was "inappropriate" since serum hypotonicity normally inhibits secretion of ADH. Recently, a bio-assay for ADH in mammalian plasma has been developed. Bower and associates utilized this method in a patient with undifferentiated bronchogenic carcinoma, who manifested typical features of inappropriate antidiuretic hormone (IADH) syndrome to the point of water intoxication. They demonstrated increased ADH in the circulating plasma and tumor. Thus, release of ADH was not the result of interference with intrathoracic volume receptors or their afferent vagal fibers, or to secretion of a substance by the tumor which released ADH from the posterior pituitary. Other pulmonary diseases such as severe bacterial pneumonia and far-advanced tuberculosis are associated with a similar type of hyponatremia. It has also been associated with a wide variety of structural and/or functional disturbances of the central nervous system, such as brain tumors, cerebrovascular disease, diffuse encephalitis, cerebral injuries, tuberculous meningitis, bulbar poliomyelitis, porphyria, and myxedema, in which there is probably abnormal release of endogenous ADH.

The majority of patients have asymptomatic hyponatremia. Symptoms of water intoxication usually occur when the sodium level is 110–115 mEq/liter or less. However, the rate of reduction by dilution is also important, inasmuch as severe symptoms have been reported at a serum sodium level of 120 mEq/liter and, conversely, much lower levels have been tolerated without symptoms. Increase in total body water causes an increase of intracellular water with cellular swelling. This is primarily reflected in interference with function of the central nervous system. Symptoms include anorexia, nausea, difficulty in concentration, irritability, apathy to severe aggressiveness, confusion, headache, muscular weakness, decreased reflexes, convulsions, and coma. Diffuse electroencephalographic abnormalities may be seen. Pathologically, vacuolization of the cytoplasm, swelling of the nucleus, and liquefaction of the neurons have been observed. The four patients to be presented have been seen over a two-year period, emphasizing the relative frequency of water intoxication.

Case Reports

Case 1. A 46-year-old Caucasian male had enjoyed good health until 16 days prior to hospitalization. A mild sore throat of three days was followed by two weeks of severe right temporal and retro-orbital headaches, listlessness, easy fatigability, poor memory, and lethargy. He was hospitalized elsewhere and the initial physical examination was normal. The following day, diffuse muscle weakness and intermittent episodes of confusion with inappropriate behavior occurred. Spinal fluid evaluation was normal. Despite normal skin turgor, adequate diet and fluid intake, serum sodium was 123 mEq/liter. The next day at Fitzsimons General Hospital (FGH), he complained of generalized weakness and muscle cramps.

He was a well developed, tall, slightly obese Caucasian. Vital signs were normal, and he weighed 227 pounds. Though oriented and cooperative, he had difficulty with concentration and recent memory. His speech was slow and slurred. Deep tendon reflexes were hypoactive, and diffuse mild muscle weakness was present. Skin turgor was good, and

there was no peripheral or periorbital edema. Pubic and axillary hair was normal. The testicles were normal in size and consistency.

The following data were obtained during the next four hospital days. Hematocrit, 49 percent; hemoglobin, 14.7 gm percent; WBC, 8,200, with normal differential; sedimentation rate, 30 mm/hr. BUN, 5.3 mg percent; fasting blood sugar, 84 mg percent; total serum protein, 7.9 gm percent; with 5.4 gm percent albumin. Serum calcium, 10.3 mg percent; phosphorous, 2.9 mg percent; alkaline phosphatase, 4 KA units. Serum sodium, 109 mEq/liter; urine sodium, 50 mEq/24 hr. Urinalysis was normal, with a specific gravity of 1.015. Serum osmolality was 228 mOsm/liter and urine osmolality 688 mOsm/liter. Chest x-ray, spinal fluid examination and skull films were normal. EEG disclosed generalized slowing compatible with a metabolic defect and pre-coma. Visual fields and bilateral carotid arteriograms were normal. ECG showed low voltage and nonspecific ST-T wave changes throughout. Total serum lipids were 720 mg percent, serum creatinine 1.2 mg percent, and creatinine clearance was 92 liters/24 hr. T_3 resin uptake was 25.3 percent. On the fourth hospital day, plasma cortisol level was 9.2 micrograms percent (normal, 5-25 micrograms percent).

Course in Hospital: By the second hospital day, serum sodium had fallen to 104 mEq/liter. There was no evidence of hypotension or dehydration. The serum remained hypo-osmolar to urine and the BUN and potassium were normal. Although fluid intake was restricted to 1,000 cc daily, his severe hyponatremia and clinical status were unaltered. On the fourth day, 220 gm of mannitol as a 20 percent solution was given over a 12-hour period, resulting in a diuresis of 4,330 cc of urine. Following this, the serum sodium was 115 mEq/liter. He became semicomatose, temperature rose to 103 F orally, and the blood pressure dropped to 90/60. Four hundred cc of 5 percent saline solution intravenously corrected the hypotension, but did not alter his state of consciousness or hyponatremia.

The possibility of hypopituitarism with water intoxication was then considered, in view of the failure to respond to water restriction, mannitol induced diuresis, and hypertonic saline. Accordingly, 300 mg of hydrocortisone was administered intravenously as a single dose on the fifth hospital day. During the following 12 hours, there was an additional diuresis of 4,230 cc of urine and the serum sodium and chlorides rose to 134 and 105 mEq/liter, respectively. He became fully oriented, muscle strength improved, and deep tendon reflexes and temperature returned to normal over a 12-hour period. Urinary output exceeded fluid intake by 6,150 cc, and his weight decreased from 223 to 217 pounds during the 24-hour period of diuresis following mannitol and hydrocortisone. On the sixth and seventh hospital days, an additional 300 mg of hydrocortisone was given intravenously. While on maintenance cortisone of 37.5 mg daily and fluid intake of 1,000 cc daily, his serum electrolytes, body weight, mental status, and neurological examination remained normal. One month later, cortisone was discontinued and fluid intake was progressively increased to 3,000 cc daily. At this point, his response to sodium chloride restriction to one gram daily and a standard water loading test was normal. Twenty-four-hour urinary 17-hydroxycorticosteroids on the 55th hospital day were 8.6 mg. This was followed by 750 mg of mepyrapone orally every four hours for six doses. Urinary 17-hydroxycorticosteroids rose from 8.4 to 19.3 mg/24 hr.

The patient has remained well on no medication during a two-year period since cortisone was discontinued. Baseline urinary 17-hydroxycorticoids and his response to mepyrapone have remained normal.

Two patients with IADH in whom no cause could be found have been previously described. This patient's illness initially was characterized by sore throat, headache, malaise, and listlessness. Although spinal fluid evaluation was normal, the prodrome, subsequent inability to demonstrate a central nervous system lesion, and his complete recovery suggest that an encephalitis was causative. He had severe hyponatremia and renal sodium wasting in the face of normal hydration and normal renal and adrenal function. Urine osmolality exceeded that of plasma, confirming the diagnosis of IADH. CNS manifestations and EEG abnormalities were typical of water intoxication. A three-day period of fluid restriction to 1,000 cc daily failed to correct the antidiuretic state. Accordingly, 20 gm of mannitol as a 20 percent solution was given intravenously over a 15-20 minute period every hour for 12 hours. This was followed by a 4,330 cc urinary output; yet, his serum sodium did not improve. Indeed, his clinical status further deteriorated, as evidenced by semi-coma, temperature spike to 103 F orally, and a drop in blood pressure to 90/60. This indicated a decrease in effective blood volume as a result of mannitol diuresis and its obligatory sodium loss. Four hundred cc of 5 percent saline only stabilized his status. At this point, consideration of hypopitu-

itarism with water intoxication prompted administration of 300 mg of hydrocortisone intravenously. In the ensuing 12 hours, he became mentally alert, muscle strength and deep tendon reflexes returned, serum sodium rose to 134 mEq/liter, and there was an additional diuresis of 4,230 cc of urine along with a seven pound weight loss. Plasma cortisol obtained on the fourth hospital day and subsequent normal thyroid function, as well as normal response to mepyrapone, ruled out pituitary-adrenal dysfunction. However, this must be considered since patients with unrecognized hypopituitarism may present with water intoxication following stress of surgery, trauma, or acute infection. Clinical manifestations and alterations in sodium and water distribution are similar to those observed in IADH syndrome. Fluid restriction does not correct water intoxication that occurs with hypopituitarism. Glucocorticoids are specific and life-saving. Utilizing a bio-assay technique, elevated plasma ADH values have been demonstrated in patients with adrenal insufficiency. A reduction in ADH levels in these patients can be shown following administration of carbohydrate-active steroids. Patients with bronchogenic carcinoma with IADH syndrome have afforded investigators the opportunity to evaluate the effect of corticosteroids. Pharmacological doses of desoxycorticosteroid acetate and aldosterone in these patients produce sodium retention; whereas, steroids like cortisone are less likely to be effective. In our patient, the absence of pituitary-adrenal failure and the inability of hydrocortisone to block ADH effect indicate that the diuresis following hydrocortisone administration was coincidental. Failure of this patient to promptly respond is more likely ascribed to water restriction of only 1,000 cc daily. Two hundred to 400 cc is more effective. Furthermore, mannitol as used in this case proved to be hazardous. The resulting diuresis and obligatory loss of sodium in urine rapidly decreased the blood volume causing hypotension and necessitated use of hypertonic saline. If mannitol is used to induce water diuresis, urinary sodium loss should be replaced by hypertonic saline.

Case 2. A 56-year-old white male was hospitalized 7 January 1966 for abrupt onset of fever, chills, malaise, and severe left pleuritic chest pain. He had previously been well with the exception of moderate hypertension requiring daily chlorothiazide and reserpine.

Physical examination disclosed a well developed, oriented, acutely ill, white male who was moderately dyspneic. Temperature was 102.8 F and blood pressure was 190/90. Chest findings were compatible with an extensive left lower lobe pneumonia. Purulent sputum on gram stain disclosed many polymorphonuclear leukocytes, gram-positive cocci, and diplococci. Chest film showed lobar consolidation of the left lower lobe. By the next hospital day, there was also extensive left pleural effusion. Total peripheral white cell count was 17,200, with 85 percent polymorphonuclear and 6 percent band leukocytes. Hematocrit was 44 percent; serum sodium, 132 mEq/liter; chlorides, 96 mEq/liter; potassium, 3.6 mEq/liter; and BUN, 12 mg percent. The diagnosis was pneumococcal lobar pneumonia.

Therapy consisted of 600,000 units of intramuscular procaine penicillin every 12 hours, low salt diet, IPPB, nasal oxygen, and meperidine for partial control of chest pain. Two thoracenteses during the initial 24-hour period removed 400 cc of yellow cloudy fluid which contained 17,000 white cells/mm^3, with 95 percent neutrophils. Gram stain and culture of the fluid were negative. During the initial three hospital days, his temperature gradually returned to normal, severity of the left pleuritic chest pain decreased, and the overall toxicity of his illness lessened. On the fourth hospital day, the patient was noted to be severely disoriented. There were no other neurological abnormalities. Spinal fluid was clear, the pressure was normal, and there were no cells. Sugar, chloride, and total protein content were normal. EEG disclosed an abnormally slow record with no paroxysms or focal activity. Serum sodium was 115 mEq/liter, chlorides 71 mEq/liter, serum osmolality 220 mOsm/liter, urine osmolality 425 mOsm/liter, and BUN 10 mg percent.

During the initial 24-hour total fluid restriction, urinary output was 810 cc. Twenty-four-hour urine sodium excretion was 4.1 mEq. At the end of 72 hours of total fluid restriction, urine output was 2,930 cc, 325 cc of fluid was lost by emesis, and a large unmeasured amount of fluid and sodium was lost by heavy sweating. His weight decreased from 175 to 160 pounds. Serum sodium and BUN rose to 122 mEq/liter and 37 mg percent, respectively. His sensorium gradually returned to normal at completion of this 72-hour period. At this point, a regular diet and oral fluids to 1,000 cc daily were permitted. On the eighth hospital day, the creatinine clearance was 93 liters/24 hr, and urinary 17-keto and 17-hydroxysteroids were normal at 20 and 17.1 mg/24 hr, respectively. He remained oriented and afebrile. Serial chest films disclosed gradual clearing of the lower lobe infiltrate over a three-week

period. The pleural reaction resolved more slowly, and after two months, there was only obliteration of the left costophrenic angle. During the past two years, the patient has felt well and his chest film has remained unchanged.

Despite improvement of a lobar pneumonia with a large pleural effusion by the fourth hospital day, irrational behavior associated with a serum sodium of 115 mEq/liter became apparent. There was no evidence of peripheral edema, dehydration, or renal, adrenal, cardiac, or liver failure. Urine was also hyperosmolar to serum. All the essential features of IADH secretion with water intoxication were present with one exception. Initially and during the 72-hour period of total fluid restriction, there was renal salt conservation as evidenced by the average urine sodium excretion of 4.1 mEq/24 hr. This is to be expected, since the patient had been on chlorothiazide and low-salt diet and was losing considerable sodium through extreme sweating. Patients with IADH reach a "steady state" in which sodium excretion reflects sodium intake.

Total restriction of fluid was effective in correcting the water intoxication, but there was a modest rise in BUN as a result of dehydration. A more ideal form of management would probably have been a fluid restriction to 200 cc of 5 percent hypertonic saline. The manner in which inflamed lung produces ADH is unknown. It is likely that there is a stimulus of osmoreceptors within the pulmonary venous circulatory bed which, through nerve pathways, affect the hypothalamus.

Case 3. C.M. was admitted at seven weeks of age in status epilepticus. Five days prior to admission, he received mild head trauma when his head struck a crib rail. On the day of admission, he became irritable, limp, and began having generalized convulsions.

He was well hydrated, afebrile, semi-comatose, with irregular respirations and having generalized seizures. Bilateral old cephalhematomas were noted, which had been present from birth. His anterior fontanelle was full and tense. There was a bruise over the left temporal area. His extremities were rigid, deep tendon reflexes were increased, and bilateral ankle clonus and Babinski reflexes were present.

Bilateral subdural taps were negative on two occasions. A lumbar puncture revealed a traumatic bloody tap but normal pressure. Skull films disclosed bilateral old calcifying cephalhematomas but no fracture. All cultures (CSF, stool, blood, and urine) were negative, except for a group A beta hemolytic streptococcus grown from the throat. His illness most likely represented an encephalopathy, but intracranial hemorrhage from vascular congenital anomalies remained a possibility.

Phenobarbital and diphenylhydantoin eventually controlled the seizures, but he remained comatose. Although serum sodium and chloride were normal on admission, their fall to 115 and 50 mEq/liter, respectively, on the third hospital day was accompanied by a gain in weight without edema. Serum osmolality was 250, urine osmolality was 682 mOsm, and the BUN was 4 mg percent. Dexamethasone was given for probable cerebral edema, and fluid restriction to 100 cc daily was begun on the fourth hospital day. Clinical and electrolyte improvement occurred by the fifth hospital evening when he showed signs of responsiveness and began taking oral feedings. By the sixth hospital day, the infant was normal, and an EEG was normal for his age. Prior to discharge, repeat lumbar punctures and subdural taps were normal.

He did well for one and one-half months, but then developed progressive increase in head size and increased intracranial pressure. Large bilateral subdural hematomas were surgically evacuated and his recovery was uneventful.

In retrospect, bilateral subdural hematomas were the most likely explanation for the infant's seizures. However, the difficulty in controlling seizures and persistent coma was troublesome until severe hyponatremia was appreciated. A diagnosis of IADH secretion was made because of low serum sodium, decreased serum osmolality, increased urine osmolality, normal renal function, and absence of dehydration or edema. There was dramatic improvement following water restriction. Dexamethasone was given to reduce cerebral edema.

Case 4. A 28-year-old Caucasian female, gravida 1, para 1, whose last menstrual period was 4 January 1965, was admitted the evening of 11 January 1965. That morning she awoke with profuse vaginal bleeding which persisted throughout the day. In the late afternoon, the continued bleeding and lightheadedness prompted her admission.

She was a well developed and nourished, pale, white female in no acute distress. Physical examination was normal except for a dilated and unlacerated cervical os from which there was profuse bleeding. The uterus was small and firm. There were no adnexal masses.

Two ampules of oxytocin given as a slow intravenous drip in 5 percent glucose and water as well

as intravenous conjugated estrogen failed to control vaginal bleeding. Four hours after admission, a dilatation and curettage under general anesthesia were performed. The removed endometrium showed a late proliferative phase. During the initial six hours of hospitalization, a total of 2,000 cc of 5 percent dextrose and water was given. Following surgery, two additional ampules of oxytocin were given by intravenous drip to maintain uterine contraction. There was no further vaginal bleeding. Two thousand cc of 5 percent dextrose and water was given that evening, for a total of 4,000 cc during the initial 16 hours of hospitalization. At this point, i.e., 9:00 a.m. on 12 January 1965, her uncomplicated course was interrupted abruptly by nausea, vomiting, mental confusion, grand mal convulsions, stupor, and temperature of 102 F. Seizures were controlled with intravenous amobarbital. Neurological examination failed to disclose any localizing signs, and spinal fluid pressure, total protein, chlorides, and microscopic examination were normal.

Admission hematocrit was 30 percent. Urinalysis and chest x-ray were normal. Serum sodium obtained immediately following convulsions was 119 mEq/liter, with a BUN of 3.8 mg percent. Urinary sodium was 70 mEq/liter prior to forced diuresis with mannitol. A diagnosis of acute water intoxication was made.

Therapy consisted of restriction of fluids to the intravenous route. Over the next 24 hours, 1,000 cc of 20 percent mannitol was given intravenously. This induced a urine flow of 6,100 cc. During the same period, one liter of 5 percent saline was given. Following this 24-hour period of diuresis, mental confusion, lethargy, and mild hyperthermia cleared. Serum sodium had risen to 130 mEq/liter. This patient was observed carefully for an additional four days during which time neurological examinations were normal. The patient has remained well during the past two years.

This is the sixth reported case of water intoxication induced by oxytocin administration. It is generally stated that oxytocin has little antidiuretic activity. Indeed, in a review of 2,862 cases of elective induction of labor with intravenous oxytocin, no cases of water intoxication were reported. However, the average dose of oxytocin used to induce labor is 20 mU per minute. It is only when larger doses are given accompanied by a large fluid load that water intoxication may occur. Kramar, *et al,* utilizing alcoholized rats, demonstrated a diuresis with low doses and antidiuresis with large doses. Oxytocin administered at a rate of 45 mU per minute in man is comparable to vasopressin in its effect on inhibiting water diuresis. In the five reported cases, the mU of oxytocin/min varied from 70 to over 1,300 with a water load of 203 to 470 ml/hr. The above patient received 55 mU/min of oxytocin and 333 ml/water/hr. Pain, anesthesia, and stress, which increase ADH secretion, could have been additive factors.

Summary

Two patients with transitory central nervous system disease and a patient with acute bacterial pneumonia developed the IADH syndrome with water intoxication. A fourth patient had a similar problem as a result of administration of oxytocin and 5 percent glucose and water intravenously. Convulsions, coma, low BUN and serum sodium, with normal renal function, were present. The osmolality of the serum was less than that of the urine. Neither dehydration nor pitting edema was present. Exceptionally, as in Case 2, the sodium depleted patient will conserve salt and the urine sodium will be low; nevertheless, the urine remains hyperosmotic to the serum.

Water restriction to 200-400 cc per day is effective. In the presence of coma or convulsions, a more rapid correction of serum hypoosmolality and cellular overhydration may be desired. If mannitol is used to induce diuresis, urinary sodium loss must be replaced by hypertonic saline. In Case 1, this initially was not accomplished, and hypotension and semi-coma occurred. Hypopituitarism with water intoxication must always be considered in the differential diagnosis, since water restriction is not effective. Administration of a glucocorticoid is specific.

(The references may be seen in the original article.)

HYPERPARATHYROIDISM AND PEPTIC ULCER DISEASE

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The first hyperfunctioning parathyroid carcinoma with metastases was reported in 1939 by Meyer. The association of peptic ulcer and hyperparathyroidism was emphasized by Rogers in 1946 and by Rogers et al in 1947. In 1950, Haynes reviewed all cases of hyperparathyroidism seen at the Mayo Clinic and found that 24 percent of the patients with proved hyperparathyroidism had at the time of examination, or in the past, objective evidence of peptic ulcer or surgical procedures presumably for ulcers. The majority of the ulcers were duodenal. An additional 15 percent to 20 percent of the patients had ulcer-like symptoms.

The first question that must be investigated in a discussion of the relationship between hyperparathyroidism and peptic ulcer is whether the concurrent incidence of these two diseases is higher than the corresponding incidence of peptic ulcer in the general population. Unfortunately, this is not feasible since investigations to determine the incidence of peptic ulceration in the general population have produced variable results. Falconer found the incidence of peptic ulcer to be 18.14 percent in men and 17.86 percent in women. Alsted, on the other hand, estimated the mean incidence of peptic ulcer at autopsy to be 4 percent to 5 percent. Watkinson estimated the incidence of peptic ulcer in England and Scotland at 8.3 percent in men and 3.9 percent in women. Statistics from all sources indicate that between 7 percent to 10 percent of our population is afflicted with this disease within their life time.

The larger series of hyperparathyroidism reported in the literature confirm the association of peptic ulcer and hyperparathyroidism. Black found that 24 percent of the patients with hyperparathyroidism had proved peptic ulcer and an additional 15 percent to 20 percent had ulcer-like symptoms without definite proof of ulceration. Most of the ulcers were duodenal in location. Howard et al reported an incidence of peptic ulcer of 15 percent. In 1954, Hellstrom reported 50 cases, 14 percent of which had duodenal ulcers. St. Goar found a 9 percent incidence of peptic ulcer in two different series of patients with hyperparathyroidism. Ostrow and Gray, in a composite review of 429 unselected patients with primary hyperparathyroidism, found the frequency of peptic ulcer was 9.1 percent. Frame and Haubrick conducted a survey of 300 ulcer patients and found only four patients with hyperparathyroidism (1.3 percent). They felt that perhaps too often a diagnosis of peptic ulcer is accepted without appreciation of any provocative or underlying endocrine and metabolic disturbances.

The clinical features of peptic ulcer in hyperparathyroidism are not unusual. As in the general population, peptic ulcer is approximately two to three times as frequent in males and duodenal ulcer outnumbers gastric ulcer by a ratio of 4:1. There is a 33 percent incidence of complications due to ulcer which is similar to peptic ulcer disease in the general population. There are, however, three distinctive features: (1) the striking preponderence of duodenal ulcer among females, (2) the relatively high frequency of gastric ulcers among males, and (3) the absence of gastric hypersecretion.

The coexistence of the two disorders is not always recognized. Ulcers associated with hyperparathyroidism are more refractory to medical or surgical therapy yet heal promptly following removal of the abnormal parathyroid gland or glands. St. Goar observed no recurrence of ulcer symptoms after parathyroidectomy in five cases followed for one to 20 years. Schneider and Robnett described a similar case. The behavior of the ulcers associated with hyperparathyroidism may follow one of three patterns: (1) they may heal spontaneously or after gastric surgery with persistent hyperparathyroidism; (2) the ulcer may persist with temporary remissions but heals with parathyroidectomy; (3) the ulcer persists even if the hyperparathyroidism has been arrested by surgery in which case one must consider multiple adenomas of other endocrine systems (Wermer's syndrome). There is no parallelism between the severity of distress due to the ulcer and the severity of hyperparathyroidism. In many cases of hyperparathyroidism ulcer-like symptoms and vague abdominal complaints are observed in the absence of any demonstrable peptic ulcer. For this reason, Ostrow and Gray are of the opinion that the relationship of peptic ulcer to hyperparathyroidism is exaggerated in the literature.

In a limited review of the experimental literature we have found that the chronic duodenal or gastric ulcer as seen in clinical hyperparathyroidism has not been reproduced in experimental animals by the

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administration of parathyroid hormone, intravenous calcium salts or vitamin D. Collip and Blanshard et al have shown that large doses of parathyroid extract do produce intramuscosal hyperemia, petechial hemorrhages and necrosis of the fundic glands within the stomach of dogs and rats. However, these lesions are distinctly different from those observed in man. Multiple superficial ulcerations of the stomach develop in rats after two to ten days of the massive administration of the parathyroid hormone. However, severe hypercalcemia induced by intravenous calcium salts or vitamin D produced identical lesions. Babkin failed to produce gastric lesions in animals by prolonged administration of small doses of parathyroid hormone or by larger doses of parathormone if marked hypercalcemia was avoided. Experimental studies by Ostrow indicate that the administration of parathyroid hormone does not increase the gastric secretion of water, chloride, acid or pepsin in rats. Babkin and Schiffrin reported that the administration of parathormone decreased the postprandial gastric secretion of water and acid in Pavlov pouch dogs but did not alter the histamine-induced secretion of acid from vagally denervated gastric pouches. These authors concluded that parathyroid hormone primarily influenced gastric secretion by hypercalcemic inhibition of the vagus nerve.

The administration of parathyroid hormone does not appear to influence gastric secretion consistently in man. Donegan and Spiro found no significant change in the output of gastric acid after the administration of parathormone or calcium gluconate to eight normal human subjects or after the excision of the parathyroid adenoma in five patients with hyperparathyroidism. Bauer reported a diminution in gastric acidity in human subjects given irradiated ergosterol.

Since gastric secretion is not increased by the administration of parathyroid hormone or hypercalcemia, the possibility that hyperparathyroidism may produce peptic ulceration by some other mechanism has been investigated. Many of the gastrointestinal symptoms of hyperparathyroidism have been attributed to altered gastric intestinal motility on the basis of impaired neuromuscular activity secondary to hypercalcemia. There is no documented evidence that gastrointestinal activity is abnormal in hyperparathyroidism nor is there any demonstrated relationship between neuromuscular activity and the onset or beginning of peptic ulcer in hyperparathyroidism.

Studies by Engle indicate that there may be a direct action of parathyroid hormone upon bone microprotein-mucopolysaccharide complexes with the release of calcium as a consequence. Excess parathormone could conceivably liquify gastric mucus thus destroying its function of protecting the mucosa against peptic-acid digestion. Alternatively parathormone may destroy the ground substance of the gastric mucosa. This could possibly account for the necrosis and calcification of the gastric glands which occurs in animals receiving excessive amounts of parathormone. All of these theories have yet to be proven. Recently, Menguy found an increase in the mucosal content of mucus during the administration of parathyroid hormone. This increase in mucous content was antagonized by cortisone administration and parathyroid hormone prevented the formation of steroid ulcers when cortisone was given. This antagonism between cortisone and parathyroid hormone has also been observed by Bradford et al. Most experimental studies show that the secretion of gastric juice diminishes when parathormone, vitamin D, or calcium (Ca^{++}) salts are given. On the basis of experimental and clinical data hypersecretion of acid is probably not an important factor in peptic ulceration associated hyperparathyroidism. The exact mechanism that initiates peptic ulceration in hyperparathyroidism has not yet been clarified.

In an attempt to determine the relationship between hyperparathyroidism and peptic ulcer seen at the Minneapolis Veterans Administration Hospital from 1948 to 1965, 23 cases of primary hyperparathyroidism were reviewed. In this series of patients the diagnosis of hyperparathyroidism and peptic ulcer was established in the absence of renal disease in six patients and in the absence of demonstrable bone disease in five patients.

The incidence of peptic ulcer disease in our series is 30.5 percent. There are 23 cases of primary hyperparathyroidism proved histologically. Twenty cases of adenoma and three cases of primary hyperplasia. Of these 23 cases, seven had a history of ulcer disease with abnormalities on studies with x-ray and/or gastrocamera (Table 1). We have included only the patients in which a x-ray diagnosis of peptic ulcer was made. Patients with gastrointestinal symptoms in which the x-ray diagnosis of ulcer was not made were not included in this study. Six patients had duodenal ulcer and one patient had a gastric ulcer. Two of the patients had ulcer craters demonstrated by x-ray. The confusing picture presented by these patients is demonstrated by the following case summary.

TABLE 1.—*Patients With Peptic Ulcer Diagnosis and Hyperparathyroidism*

Case No.	Age at Onset of Symptoms	Age at Diagnosis	Site of Ulcer	Ulcer Therapy	Ulcer Symptomatic	Deformed Duodenal Bulb by X-ray	Ulcer Crater by X-ray	State of Ulcer After Parathyroidectomy	Observation Period Postoperatively
130-178	33	49	Duodenum	Yes	Yes	Yes	No	Improved	18 mo; no GI symptoms
110-714	28	66	Duodenum	Yes Surgery	Yes	Yes	No	Improved	Lost of follow up no symptoms on discharge
118-311	27	27	Duodenum	Yes	Yes	Yes	No	Improved	6 yr; no GI symptoms
150-262	74	75	Gastric	Yes	Yes	Yes	Yes	Improved	18 mo; no GI symptoms
940-780	33	41	Duodenum	Yes Surgery	Yes	Yes	Yes	Improved	3 yr; no GI symptoms
104-125	25	55	Duodenum	Yes	Yes	Yes	No	Improved	2 yr; died of renal disease
109-124	44	61	Duodenum	Yes	No	Yes	No	....	10 yr; no GI symptoms

A 75-year-old retired salesman (150-262) had symptoms of mental confusion, abdominal pain, headaches, and hypertension. Five years prior to this admission he had a normal upper gastrointestinal series. Two months prior to admission to this hospital the patient lost 4.5 kg (10 lb) and had three episodes of vomiting. His abdominal pain was relieved by meals and antacids. He had no melena or hematuria. An upper gastrointestinal series revealed a gastric ulcer on the lesser curvature. Gastrocamera confirmed this finding.

Physical examination was essentially within normal limits. Laboratory studies revealed the following values: hemoglobin, 10.5 gm/100 cc; urinalysis, trace of albumin and many white blood cells; urine culture, negative; blood urea nitrogen 15 mg/100 cc; creatinine, 1.9 mg/100 cc; fasting blood glucose, 112 mg/100 cc; serum calcium ranged from 10.2 mg/100 cc to 11.6 mg/100 cc; serum potassium ranged from 1.8 mEq/liter to 2 mEq/liter; and alkaline phosphatase, 8 units. At surgery, a 1.5-cm parathyroid adenoma of the clear cell type was removed from the lower pole of the right lobe of the thyroid gland.

TABLE 2.—*Age of Onset of Symptoms and Diagnosis of Hyperparathyroidism*

Age	Patients With Ulcers	Patients Without Ulcers
Average age onset of symptoms	37.7	35.4
Mean age onset of symptoms	33	34
Average age diagnosis of hyperparathyroidism	52	45.4
Mean age diagnosis of hyperparathyroidism	55	47

The average age of the ulcer patients when hyperparathyroidism was diagnosed was 52 years with a median age of 55 years (Table 2). In the group without ulcer disease the average age at diagnosis was 45.4 and the median age 47 years. The age at which ulcer symptoms first appeared varied from 27 to 75 years with an average of 37.7 years and a median age of 33 years. In comparison, the age at which other hyperparathyroid symptoms occurred varied from 18 years to 67 years with an average of 35.5 years and a median age of 34 years. The symptoms of hyperparathyroidism started long before the disease was diagnosed. The group of patients with ulcer disease had their diagnosis of hyperparathyroidism made at a later age. Two of the patients had surgery for their ulcer disease prior to the diagnosis of hyperparathyroidism. In six cases, the ulcer symptoms appeared before those of hyperparathyroidism.

The pathologic changes in the parathyroids consisted of a single adenoma in all seven cases. Primary hyperplasia and carcinoma were not observed in this series. The locations of the adenomas were primarily in the lower parathyroid glands. The right lower gland was involved four times and the left lower gland was involved three times. In one case the left upper gland was involved.

The treatment of hyperparathyroidism is surgical. No blocking agent comparable to the antithyroid agents has been found and the high incidence of neoplasm makes it unlikely that such a drug would have a place in the therapy until a method is found to differentiate between neoplasm and hyperplasia. Radiation therapy either by deep radiation or by a

radioactive-tagged molecule has not proved feasible. The surgical problem is two-fold. The identification of the parathyroid glands and determination of the pathologic type of enlargement present. Cope stresses that a meticulous, bloodless technique is essential to find parathyroid tissue and that parathyroid explorations are unsuccessful because of the surgeon's failure to realize that the tumors are often small and are easily hidden by a thin film of blood. Identification of the pathologic type of parathyroid enlargement is of prime concern to the surgeon since the surgical management of a parathyroid adenoma and diffuse hyperplasia of all the glands is different. In 230 patients operated on at Massachusetts General Hospital for primary hyperparathyroidism, Cope found that 13 percent of patients with hyperparathyroidism had hyperplasia of the glands and 4 percent had carcinoma. During removal of the adenoma one should identify the normal glands. There is a rough correlation between the size of the adenoma and the degree of hyperparathyroidism. The presence of hyperplastic glands is more difficult to identify since all four glands may be enlarged. If so, it is necessary to resect three of the four glands and partially resect the fourth. If the fourth is smaller, it may be biopsied and left in place. Another consideration is the possibility of a fifth or superior mediastinal gland.

Carcinomas are rare but should be recognized at the first exploration. They are hard and whitish as opposed to the soft brown tissue of benign glands. They are usually surrounded by a fibrous tissue reaction as if an inflammatory process was present. Cope and Castleman feel this inflammatory-like reaction is the best indication that wide excision is to be done. Care should be taken not to rupture the capsule as implantation may occur. Lymph nodes should be removed when there is any suggestion of their involvement.

Summary

Hyperparathyroidism is readily diagnosed in its severe overt form. It is not difficult to make the diagnosis in a patient with diffuse skeletal deformities and renal stones. In a patient with a mild degree of the disease, the diagnosis is much more difficult and can be made only when it is thought of and many times only after repeated careful laboratory studies.

In 23 cases of primary hyperparathyroidism seven patients were found to have peptic ulcer. Six had duodenal ulcer and one patient had a gastric ulcer. Six patients had symptoms referrable to their gastrointestinal tract and peptic ulcer disease prior to the diagnosis of hyperparathyroidism. Two had surgical procedures done for their ulcer disease. The symptoms of peptic ulcer disease were relieved after removal of the parathyroid adenoma in all the patients.

The study supports the concept that there seems to be an association between peptic ulceration and hyperparathyroidism. The pathogenesis of these ulcers is unknown. Patients having peptic ulceration resistant to medical or surgical therapy should be examined for the presence of hyperparathyroidism.

(The references may be seen in the original article.)

THE CHANGING PATTERN OF BACTERIAL ENDOCARDITIS

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All bacteria and fungi are capable of producing endocarditis. Host and environmental factors alter the incidence of infectious diseases in man. Bacterial endocarditis has been affected by many changes in recent years. By far, the most common organism causing this disease before 1940 was the alpha-hemolytic streptococcus, but since then the incidence of this organism has progressively decreased while staphylococci and other organisms have increased. Cardiac surgery has led to new cases of endocarditis, particularly those due to Staphylococcus epidermidis. The long treatment schedules for patients with a variety of diseases can lead to the depletion of the body defenses against bacteria and fungi, leading to an increased number of cases of endocarditis. The presence of increasing numbers of patients in urban communities addicted

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to various drugs such as heroin and morphine has led to a different type of endocarditis. These and many other causes have led to a change in the pattern of endocarditis as contrasted to the situation before 1950.

The division into acute and subacute varieties is useful because certain organisms, e.g., Staphylococcus aureus and pneumococcus, more frequently produce the acute syndrome, while alpha-hemolytic streptococci usually cause a subacute disease. The classification into acute and subacute frequently can be made only retrospectively, and for therapeutic reasons, it is more important to determine the etiologic agent than to decide the speed of the clinical manifestations.

Rarely, rickettsiae can cause endocarditis. Viruses are known to produce endocarditis in experimental animals but not in humans. The true incidence of endocarditis is difficult to assess. Incidence in any one institution will vary with the frequency of referral of patients, with the changing criteria used to accept the diagnosis, and with other factors, such as the frequency of cardiac surgery. At the University of Iowa the incidence has not changed greatly since 1924 but others report a reduction in incidence of endocarditis.

Who contracts endocarditis? Most patients developing this disease have a preexisting cardiac lesion—this has usually been rheumatic, but with increasing frequency, it is of a congenital nature. The patient usually is between the ages of 20 and 50 years and is slightly more often male than female. It is unusual to see the disease in patients under 10 or over 65 years of age. The patient may have a history of pharyngitis or upper respiratory infection, extraction of teeth or extensive dental manipulations, operation or instrumentation of the genitourinary tract, or abortion. Patients undergoing heart surgery develop endocarditis more often after cardiopulmonary bypass procedures than after the closed type of operation.

Between 40 and 73 percent of patients with infectious endocarditis have evidence of previous rheumatic heart disease. About 42 percent of the men have combined aortic and mitral valve lesions, whereas this is true in only 22 percent of the women. In contrast, 66 percent of women have only mitral valve involvement; this is true in only 31 percent of the men.

The Typical Patient

A middle-aged man will present with a fever and will have a history of previous heart disease. In general, his disease has been of gradual onset and may be associated with shaking chills and sweats. A routine history, physical examination, and laboratory scan will fairly readily eliminate infection in the throat, ears, chest, and urinary tract as the source. Careful examination of the conjunctivae, mouth, hands, and feet will show petechiae in at least 50 percent of the patients. The range of this phenomenon is 26 to 86 percent. The petechiae may be discrete, single, or at least not very numerous, but their detection is of the utmost importance. Splinter hemorrhages under the nail bed have less diagnostic value because they can be found in normal elderly persons, in people with noninfectious heart disease, and as a consequence of trauma in normal daily work.

The symptomatology of the patient with infectious endocarditis is nonspecific. Fever is felt by most patients, but its magnitude has a wide range of variation. It is found in the first 24 hours of hospitalization in 97 to 100 percent of patients. It has no particular pattern and may vary in extent. It may be absent in elderly patients and in patients with uremia or congestive heart failure and particularly in those who already have received small doses of antibiotics and those on steroid therapy. In patients on steroids, a tachycardia may be the only suggestion that fever has been abolished by the medication. Other nonspecific symptoms include anorexia, weight loss, fatigue, and lassitude. Occasionally an embolus heralds the onset of the disease. Embolism occurs to the spleen, kidney, brain, retina, lungs, and limbs. Eighty-five to 99 percent of the patients have one or more heart murmurs. Those who do not have heart murmurs more frequently have an acute bacterial endocarditis due to Staphylococcus aureus. Rarely, patients with endocarditis have the sudden appearance of a murmur due to rupture of a valve leaflet. Changing murmurs occur in less than 10 percent of the cases, and often this observation is made after the diagnosis has been established. This is an overrated sign. Splenomegaly is a very important feature in endocarditis, occurring in 43 percent of the patients. If palpation is doubtful, an x-ray of the abdomen can be helpful, and occasionally a radioactive scan with technetium is revealing. Funduscopic abnormalities consisting of flame-shaped hemorrhages, retinal thrombosis, Roth spots, petechiae, papilledema, and other evidence of emboli are found in 17 percent of the patients.

Osler nodes and Janeway lesions are probably the only characteristic signs of endocarditis. Osler nodes

are pea-sized, painful, and tender nodules of the fingers and toes which come out at intervals and may pass away in 1 or 2 days. They are present in about 10 percent of the patients. The tips of the fingers may be slightly swollen. Janeway lesions are painless, red-blue hemorrhagic lesions a few millimeters in diameter. They occur in the palms and the soles in about 5 percent of the cases.

On the average, the patient with endocarditis has been ill from 3 to 12 weeks, depending mainly on the nature of the causative organism. Endocarditis caused by Staphylococcus aureus and Staph. epidermidis is related to a shorter prehospitalization illness than that caused by the streptococcus group.

Less Common Varieties of Endocarditis

Endocarditis following cardiac surgery usually occurs in the first 4 weeks. Often the fever is of minor degree. Petechiae, emboli, and splenomegaly are unusual. The incidence is about 1 or 2 in 100 operations, and it occurs particularly in patients who have had cardiovascular surgery with bypass procedures. Sometimes the patients will not recover without removal of sutures or removal of prosthetic material.

Endocarditis in addicts is most often associated with Staphylococcus epidermidis in heroin addicts and streptococci in opium addicts.

Endocarditis due to Streptococcus faecalis frequently is a complication of urinary tract infections or urinary tract instrumentation. It occurs after septic abortion and septic intravenous injections. It has followed prostatic surgery. Most of the male patients are over 45 years of age, while the women are in the child-bearing period from 20 to 40 years of age. It is not uncommon to have gross abscess formation, particularly in the spleen, during the course of the disease. The enterococcus is distinguished by its ability to grow in 7.5 percent NaCl, to grow at a temperature of 45° C., and to be agglutinated by group I antistreptococcal serum.

Endocarditis due to fungi is a rare disease but it is becoming more common in patients debilitated from any cause. Sometimes, such as in patients with histoplasmosis, the signs and symptoms of the generalized disease are similar to those of endocarditis, and the diagnosis may not be made until autopsy. The patients usually have spiking fever, emboli, hematuria, clubbing of the fingers, anemia, and splenomegaly. Because of the large size of the vegetations, emboli lodge in the large vessels in many cases. Candida and aspergillus species and Histoplasma capsulatum account for 50 percent of fungal endocarditis cases.

Endocarditis in the Elderly. No heart murmurs are detected during life in 10 to 20 percent of elderly patients. This and other atypical clinical features explain the fact that approximately 70 percent of such patients die in the hospital, as against 20 to 30 percent of the younger patients. A murmur, fever, and possibly an anemia may be the only signs of endocarditis in some patients, while in others associated active disease may mask the signs and symptoms of the endocarditis. Commonly, the associated disease may be a cerebrovascular accident, a myocardial infarct, a genitourinary infection, or a carcinoma. Others will present with a psychosis and fever and with cerebral hemorrhage following a septic embolus. Renal insufficiency occurs commonly in this age group. Of the patients with endocarditis, the elderly are making up an increasing fraction.

Culture-Negative Endocarditis. Patients with negative blood cultures who have evidence of systemic infection, heart murmurs, and embolization are difficult diagnostic problems. In any large series, 10 to 20 percent of the apparently obvious cases of endocarditis have negative blood cultures. This occurs most commonly when antibiotic therapy has been administered before obtaining the cultures.

We believe it is preferable to treat as having endocarditis a few patients who do not have the disease than to fail to treat some who do have it.

Bacterial Endocarditis and Rheumatic Fever Prophylaxis. Patients receiving rheumatic fever prophylaxis develop bacterial endocarditis at approximately the same frequency as those who do not receive it. Endocarditis is very likely in those patients receiving prophylactic therapy when the presenting problems are petechiae, Janeway lesions, Osler's nodes, splenomegaly, a new murmur, hemiplegia, or meningitis. Arthralgia and arthritis are common in endocarditis, and thus the differential diagnosis from rheumatic fever is not always easy. Blood cultures should be taken to rule out endocarditis.

Diagnosis

The clinical manifestations of endocarditis derive from the destruction of valves, from the embolization of parts of the vegetation, and from the toxic products of the organisms released into circulation. Any patient with a heart murmur who has fever for 2 or 3 weeks or longer should be suspected of having endocarditis. Growing the organism from the patient's blood is the most important test in endo-

carditis. We find that the timing of blood cultures is of little importance except in avoiding the transient bacteremia from instrumentation or from manipulation of a septic focus. We take our cultures at least 2 hours apart, since many studies of transient bacteremias have shown that the bacteria disappear from the blood within 1 hour. Ordinarily the bacteremia of bacterial endocarditis is not an intermittent phenomenon. Ninety-eight percent of all positives will be obtained in the first 2 days of culturing the blood. We take six blood cultures initially and grow them aerobically and anaerobically. If there is the slightest suspicion of the presence of a fungal infection, we add 5 ml. of blood to heparin in a tube before inoculating it on appropriate media. We do not routinely add penicillinase to the blood cultures, as there is a small problem of contamination here. However, if penicillin is being given to the patient, we do add penicillinase to each bottle. We have had no added advantage from bone marrow cultures over blood cultures. Other methods of nullifying antimicrobial agents are the addition of 0.1 percent saturated solution of paraaminobenzoic acid (PABA) to neutralize sulfonamides, the use of metallic salts or cystine to neutralize tetracycline, and the washing of the clot in sterile saline before grinding and inoculating. Another method is to filter blood through a millipore filter and wash the filter to eliminate residual antibiotic. The ratio of blood culture medium should be about 1:20, and most bottles for blood culture should receive 5 ml. of the blood and no more. The organisms isolated from our cases at the University Hospitals are shown in Table 1.

Culture of all septic areas from patients suspected of having endocarditis can be helpful, particularly when organisms cannot be isolated from the blood.

Determination of the exact sensitivities of cultured organisms to the proper antibiotic is *mandatory*. The usual method of disc sensitivity is adequate for less severe infections, but it indicates only bacteriostatic levels of sensitivity to a fixed dose of antibiotic. In the case of penicillin G for example, most laboratories test the organism with discs containing 2 and 10 units of the antibiotic. The great need is to know if the organism will be inhibited and killed by 0.1 or 0.2 or more units per ml. of penicillin G. This determination must be done by the tube dilution method. In addition, 24 hours after treatment is begun, the patient's serum must be titrated against his own organism. That is, it is diluted 1:4, 1:8, 1:16, etc., and to it a small number of organisms is added. If a particular tube is clear the next day, this indicates a bacteriostatic level. If, on subculture, the inoculum is sterile, this indicates a bactericidal level at that dilution. To be assured of adequate treatment, all patients should have a bactericidal level of 1:4 or, better still, 1:8 or higher.

TABLE 1.—*Bacteriology in Endocarditis (University of Iowa Hospitals)*

	1940 To 1949	Percentage	1950 To 1963	Percentage
Alpha hemolytic streptococcus	84	73	47	33
Other streptococcus	6	5	15	11
Staphylococcus aureus	11	10	26	19
Staphylococcus epidermidis	0	0	7	5
Hemophilus influenzae	0	0	2	1
Brucella species	1	1	2	1
Fungus	0	0	3	2
Other	10	9	3	2
No organisms	4	3	36	26
Total	116		141	

One-third of the patients will demonstrate some abnormality in the urine, and urine should be examined for red blood cells, hemoglobin, and albumin. One of the best indications of embolization available is the finding of red blood cells in the urine.

The white blood cell count is not very helpful in the primary diagnosis of endocarditis, but a leukocytosis of 13,000 or higher suggests a staphylococcal infection, while a lower count is a hint of an alpha-streptococcal infection.

Most patients with endocarditis eventually develop a significant anemia, but it takes longer in those with a streptococcal than it does in those with a staphylococcal infection. Eight-eight percent of our patients with endocarditis had less than 12 gm. of hemoglobin on arrival at the hospital, but in all of them, it reached this level by 10 days after admission. A level of 10 gm. or less suggests a staphylococcal infection. Ninety percent of patients have an increased erythrocyte sedimentation rate and 50 percent may have the rheumatoid factor present in their serum.

Differential Diagnosis

Septicemia. The essential difference in endocarditis is the presence of embolization. This may be indicated by petechiae or by red cells in the urine or by major embolic accidents.

Fever After Cardiac Surgery. After cardiac surgery most patients have some fever, but it usually returns to normal levels within 4 or 5 days.

The postpericardiotomy syndrome usually manifests itself 2 weeks to 6 months after surgery as fever, signs and symptoms of pleuritis and peri-

carditis, arthralgia, and myalgia. Leukocytosis, an elevated erythrocyte sedimentation rate, and positive C-reactive protein are expected, but blood cultures are sterile.

The postperfusion syndrome of fever, splenomegaly, lymphadenopathy, and atypical lymphocytes in the blood smear has been reported in 3 to 11 percent of patients having cardiac surgery with the use of extracorporeal circulation. The clinical manifestations begin 3 to 4 weeks after the surgical procedure. The heterophil test is positive in less than 10 percent of the patients. The lymphocytes resemble the atypical cells seen in the infectious mononucleosis. Often the apparent well-being of these patients contrasted with those with endocarditis is quite striking. Treatment with antibiotics is not required, and the signs and symptoms often are short lived.

Prevention of Bacterial Endocarditis

Bacteremia, although transitory, constitutes a potential threat to an individual with rheumatic or congenital heart disease. The following types of procedures are likely causes of bacteremia: tooth extraction and other oral surgical procedures, manipulation of the periodontal tissues, removal of tonsils and adenoids, bronchoscopy, and instrumentation of the genitourinary tract. Procedures with lesser risk of bacteremia are cardiac catheterization, sigmoidoscopy, childbirth, and surgery of the lower intestinal tract. A suitable prophylactic regimen is shown in Table 2.

Treatment

Patients with bacterial endocarditis should be confined to a hospital that has an adequate bacteriologic laboratory. Mistakes in the bacteriologic identification of the causative organism or in the regulation of treatment may lead to death. If the diagnosis is clinically certain, the patient should be told that he will spend up to 6 weeks in the hospital. The very ill should be confined to bed, but this should not be unduly prolonged, because of the added risk of venous thrombosis and pulmonary embolization.

Antibiotic therapy is determined on the basis of the organism causing the endocarditis. Suggested antibiotics are listed on Table 4. The bactericidal antibiotics are the penicillins, the cephalosporins, vancomycin, and streptomycin. The length of treatment is directly related to the sensitivity of the organism to the antibiotic being used. In general, short treatment of 2 weeks' duration can be considered only in patients with the recent onset of bacterial endocarditis due to a very sensitive organism. The length of treatment has been developed on a purely empirical basis because the relapse rate following 1 or 2 weeks of treatment has been such that 3 or 4 weeks have been tried and still later 5 or 6 weeks.

The antibiotic drugs should be given intravenously or intramuscularly unless the onset of endocarditis is recent and due to a very sensitive organism. In addition, it should be shown that the patient absorbs the oral antibiotic in an amount sufficient to make the serum bactericidal test positive at a level of 1:8 or higher.

Treatment of Patients Allergic to Penicillin. We prefer to treat patients who are allergic to penicillin with cephalothin or cephaloridine, and in our experience it is safe. However, we insist that a physician observe the first injection and that he be prepared to deal with a serious hypersensitivity reaction. Alternative drugs are vancomycin and bacitracin. Adrenal steroids sometimes are used to suppress delayed sensitivity when use of penicillin is considered crucial. Some patients have received bacteriostatic antibiotics such as lincomycin or tetracycline, but this is a less satisfactory method of therapy. The use of probenecid (Benemid), 2 gm. orally in divided daily doses, will approximately double the blood levels of penicillin at lower dose

TABLE 2.—*Prophylaxis of Endocarditis in High-Risk Patients*

Operation	Duration of Prophylaxis	Daily Dose
Dental extraction* or ENT surgery	Day 0 to +2	Penicillin V, 1,200,000 units, a.c., p.o., divided doses †
or		
Dental extraction or ENT surgery	Day 0 to +2	Procaine penicillin G, 600,000 units b.i.d., I.M. †
Toncillectomy	Day −1 to +2	Procaine penicillin, 600,000 units, b.i.d., I.M. †
Urologic manipulation. D & C for incomplete abortion. Extensive GI system surgery	Day 0 to +2	Procaine penicillin, 2,400,000 units, I.M., and streptomycin, 2 gm., I.M. †
Cardiac surgery	Day 0 to +2	4 to 6 gm. methicillin, I.M., or oxacillin

* If patient has recently received antibiotic treatment, streptomycin should be added, 1 gm. daily.
† Substitute cephalothin 0.5 gm., I.M., for 600,000 units penicillin or 1 gm. of methicillin if pateint is allergic to penicillin.

TABLE 3.—*Content of Sodium and Potassium in Commonly used Antibiotics*

	Mg.	mEq.	
Penicillin G (Na)	40	1.7	per million
Methicillin (Na)	50	2.1	per gm.
Oxacillin (Na)	57	2.4	per gm.
Cephalothin (Na)	58	2.5	per gm.
Colistin (Na)	50	1.7	per 150 mg.
Penicillin G (K)	65	1.6	per million

levels. Also, probenecid will increase the blood levels of the cephalosporin drugs. It is less effective at high dose levels.

Treatment in the Presence of Complications. In renal failure, the excretion of penicillin, vancomycin, and streptomycin is decreased and the dose of these antibiotics should be decreased. In the anuric patient, penicillin can be given every 12 hours, and streptomycin, 0.5 gm. every 2 to 3 days. Vancomycin should not be used unless facilities are available to determine its level in the blood. The amount of sodium and potassium is of importance. The sodium and potassium content of the commonly used antibiotics are shown in Table 3. Steroids do not provide any benefit in the patient with septicemia or bacterial endocarditis. Necessary dental treatment should be done as early as possible in the treatment period because the normal flora of the mouth is suppressed and replaced by hemophilus, gram-negative rods, and fungi. The use of aspirin usually is not advisable. Fever increases the action of antibiotics and presumably has a natural curative function. However, antipyretics may be needed symptomatically in adults with rectal temperatures over 105° F. or in children with fevers over 103° F. They should be prescribed at lower temperatures only for children known to convulse from fever.

Surgical Treatment. In certain situations, for example, when abscesses are present, surgical treatment must be added to the proper antibiotic management. Rarely, surgery may be necessary to remove cardiac foreign bodies, such as an infected prosthetic valve. It may be necessary to close a patent ductus arteriosus or to remove an abscessed spleen. Valve replacement has been suggested for patients who rupture an aortic valve leaf during bacterial endocarditis and valve excision or debridement has been advised for fungal endocarditis. Surgery has been

TABLE 4.—*Suggested Chemotherapeutic Regimens for Treatment of Endocarditis*

	Comment	Treatment	Route	Dose	Frequency (hours)	Duration (weeks)
Strep. viridans or Nonhemolytic strep.	Penicillin G sensitivity $\leqslant$ 0.2 μ/ml.	Penicillin G	I.M.	1.2 M*	6	4
		or	I.V.	5 M	24	4
		Penicillin G and streptomycin	Oral	1.5 M	6	4
			I.V.	5 M	24	2
			I.M.	1 gm.	12	2
	Penicillin G $>$ 0.2 μ/ml.	Penicillin G	I.V.	10 M	24	4
	Penicillin allergic patient	Cephalothin	I.V.	1-2 gm.	4	4
			I.M.	1-2 gm.	4	4
Staph. aureus	Penicillin G $\leqslant$ 0.4 μ	Penicillin G	I.V.	8 M	24	7
			I.M.	2 M	6	7
Staph. epidermidis	Penicillin G $\geqslant$ 0.8 μ	Methicillin or Oxacillin	I.V.	2-4 gm.	6	7
			I.M.			7
			P.O.			
		Vancomycin	I.V.	1 gm.	12	3
	Penicillin allergic patient	Cephalothin	I.V.	1-2 gm.	4	7
			I.M.			
		Vancomycin	I.V.	1 gm.	12	3
Strep. faecalis	Disregard in vitro sensitivities	Penicillin G and streptomycin	I.V.	10-20 M	24	6
			I.M.	1 gm.	12	6
		or				
		Ampicillin and streptomycin	I.M.	1-2 gm.	6	6
			I.M.	1 gm.	12	6
No organism isolated	Double doses of penicillin every 72 hr., twice if no response	Penicillin G	I.V.	10 M	24	7
		Streptomycin	I.M.	1 gm.	12	
	If no response, change penicillin G to methicillin	Methicillin	I.V.	2 gm.	4-6	7
β-hemolytic strep. Pneumococci or Gonococci		Penicillin G	I.M.	10 M	24	4
			P.O.			
Rickettsial		Tetracycline	P.O.	2 gm.	24	6
Fungus		Amphotericin	I.V.	1 mg./kg.	24	to total of 25 mg./kg.

* M equals million units.

TABLE 5.—*Guide to Management of Endocarditis*

1. Think *endocarditis* in presence of fever and cardiac murmur.
2. Suspect endocarditis in presence of fever, cardiac murmur, and splenomegaly or petechiae or evidence of embolization.
3. Diagnose endocarditis when *1* or *2* is present and organism is isolated from blood.
4. *Do:*
   A. Five blood cultures 2 or more hours apart (5 ml.).
   B. Add penicillinase to bottle culture if patient has received penicillin.
   C. If organism is isolated, *save it.* Do tube dilution sensitivity.
   D. Daily WBC, occas. Hct., daily urines, weekly renal function test, chest x-ray, and EKG.
5. *Don't:*
   A. Start treatment and then abandon short of recommended period.
   B. Start treatment without blood cultures.
6. *Treatment:*
   A. If illness persists longer than 4 weeks and patient is not desperately ill *wait* for 3 to 4 days until organism is identified.
   B. Choose penicillin G for treatment if possible.
   C. After 24 to 48 hours treatment, use serum bactericidal dilutions against patient's own organism. If antibiotic or route of administration changed, repeat test. At least ¼ dilution is required of serum.
   D. Treat long enough. See Table 4.
7. *Treatment problems:*
   A. Lack of improvement of fever:
      1. Antibiotic not effective: route, dose, other antibiotics.
      2. Slow response (staphylococcus, 7 days).
      3. Abscess: site of injection, kidney, spleen.
      4. Allery to antibiotic (skin rash, eosinophilia, joint pain).
   B. New fever:
      1. Embolus.
      2. Superinfection.
      3. Allergy to antibiotic.
   C. Development of cardiac failure:
      1. Aortic cusp rupture.
      2. Overdose of sodium. Check fluids and Table 2.

used to correct the deformities produced by bacterial endocarditis after the cure of the primary disease.

Prognosis. About 7 percent of patients with bacterial endocarditis suffer relapses and a second recurrence is seen in about 2 percent. For patients convalescing from bacterial endocarditis, the best criteria to assess recurrence by is measurement of the temperature every evening between the hours of 4 and 8 p.m. If a temperature of 100° F. is reached, blood cultures should be obtained. The survival rate of patients in the hospital is about 75 to 80 percent. Fifty to 70 percent of the early fatalities occur in patients in the older age groups, in those with cirrhosis of the liver, in those with a history of severe alcoholism, or in those who develop congestive heart failure during treatment. Patients with endocarditis due to resistant staphylococci, gram-negative bacilli, or pneumococci are included in the early fatality group, as well. These patients require extra care and very careful attention if they are to be salvaged. The 5-year survival rate is about 50 percent.

(The references may be seen in the original article.)

MEDICAL ABSTRACTS

TISSUE NECROSIS DUE TO NOREPINEPHRINE

MAJ J. E. Oglesby, MC USA, and LCOL J. H. Baugh, MC USA, Amer J Surg 115(3):408–412, March 1968.

A dramatic case of skin and subcutaneous slough of the leg secondary to the administration of norepinephrine is presented. The attendant morbidity of this complication is pointed out and a cross section of similar cases reported in the American literature referred to regarding healing times, required therapy, and prophylaxis. A brief review of the problem and modes of prevention and therapy is presented.

CLEAN WOUND INFECTIONS: EPIDEMIOLOGY AND BACTERIOLOGY

Stuart R. Snider, MD, Surgery 64(4):728–735, Oct 1968.

Factors influencing the incidence of clean wound infections were investigated in postoperative infections on all surgical services at Highland General Hospital during a one year period (1966). After screening out all questionable data, there were 76 cases carefully selected from 4,037 operations from which the following results could be analyzed:

1. Recorded infection rates by service ranged from 2.4 percent in urology to 7.7 percent in thoracic

surgery and increased in proportion to the duration of the operative procedure.

2. Rates of infection varied from month to month in no consistent pattern but infection rates for some commonly performed operations were similar to rates reported at other institutions.

3. Infection risk was greater in patients over the age of 50, and infections were infrequent below the age of 30.

4. Penicillin-resistant staphylococcal infections were more commonly associated with a longer period of preoperative hospitalization than were penicillin-sensitive staphylococcal infections.

5. Multifilamented suture materials were implicated in suture abscesses more often than monofilament nylon.

6. Microorganisms first cultured from a wound infection tended to be mixed infections, with gram-positive and gram-negative organisms occurring with about equal frequency.

7. Penicillin-resistant Staphylococcus, Pseudomonas, Klebsiella, and Proteus were commonly cultured if the wound flora changed with treatment.

TYPHOID FEVER IN THE PREVIOUSLY IMMUNISED

W. Grossman, MD, and H. A. Berman, MD, Lancet II(7573):867–868, Oct 19, 1968.

Typhoid fever developed in six previously immunised Peace Corps Volunteers in India during a 2-year period. Observations on the time-interval between previous typhoid vaccine boosters and the onset of clinical typhoid fever led to a modification of the immunisation schedule in an attempt to reduce the incidence of typhoid fever in the volunteer population. Booster injections were given every 4½ months. It is suggested that a controlled clinical trial of this modified regimen under field conditions would be worthwhile.

GASTROENTEROLOGIC COMPLICATIONS OF ANTICOAGULANT THERAPY

R. R. Babb, MD, J. A. Spittell, Jr., MD, and L. G. Bartholomew, MD, Mayo Clin Proc 43(10):738–751, Oct 1968.

This review was written to elucidate the clinical picture and subsequent management of gastrointestinal bleeding, intra-abdominal hemorrhage, and hypersensitivity reactions in the patient on anticoagulant therapy. Although uncommon, these iatrogenic disorders are potentially life-threatening and require prompt diagnosis and treatment.

Gastrointestinal hemorrhage occurs in 3 to 4% of patients on anticoagulant therapy and is a major manifestation of serious bleeding. Each patient must be thoroughly investigated for a hitherto unsuspected pathologic process, no matter what the prothrombin time is during the bleeding episode. Hemorrhage into the intestinal wall, ovaries, adrenals, pancreas, or rectus abdominis muscle often produces an acute abdominal condition with signs of bowel obstruction. Close attention to history, physical findings, and laboratory and roentgenographic findings should allow one to make the proper diagnosis and institute appropriate therapy.

Phenindione is potentially a hepatotoxic drug. Fever and dermatitis may be the first clues to a hypersensitivity reaction, and use of the drug should be discontinued promptly if such occurs.

SUDDEN UNEXPECTED DEATH FROM NATURAL CAUSES IN YOUNG ADULTS

J. L. Luke, MD, and M. Helpern, MD, Arch Path 85(1):10–17, Jan 1968.

Cases of sudden and unexpected death from natural causes in individuals between the ages of 20 and 45 years are reviewed; the causes and circumstances of the deaths of these individuals are defined. Asymptomatic coronary artery disease and untreated infectious diseases comprise a significant percentage of these cases. The potentiating direct and indirect effects of acute and chronic alcoholism on natural disease processes of all types cannot be overemphasized and constitute a very real public health problem.

PATHOGENESIS OF ACUTE SCHIZOPHRENIC PSYCHOSIS

Malcolm B. Bowers, Jr., MD, Arch Gen Psychiat 19(3):348–355, Sept 1968.

A composite experiential account of the development of acute psychotic experience derived from interviews with fifteen acute schizophrenics is presented. Out of a state of dread, a heightened and altered experience of self and world lead to the development and maintenance of delusional ideation. Subjective experience in the development of acute psychosis highlights the ontogenetic inter-relationship between affect, self-experience, and perception in human development and psychological organization.

CHILDBED FEVER— A CONTINUING ENTITY

J. F. Jewett, MD, et. al., JAMA 206(2):344–350, Oct 7, 1968.

A serious epidemic of puerperal sepsis in May 1965, without any evident breach of technique or good practice, was traced by modern bacteriologic methods for the first time to a single reservoir and the probable source of the infection.

In the decade from 1935 to 1945, safety in childbirth gained a new horizon with the introduction of antimicrobial drugs. For this and other reasons, the resulting decrease in maternal mortality has conjured up the illusion both within the profession and out of it, that childbirth no longer entails appreciable risk to mother or fetus. The fear of infecting a parturient by cross-contamination, once considered the most likely source of puerperal fever epidemics, has evidently disappeared in the minds of many physicians and some hospital and health officials. This is reflected in the mixing of so-called "clean gynecologic" and obstetric patients on the same hospital floor. Such practice is predicated mainly on the need for more medical and surgical beds at a time when many obstetric beds are vacant due to the shortened period of hospital confinement. The same casual approach is also reflected in the philosophy of "clean glove" technique in vaginal examination during late pregnancy and even in the conduct of labor where sterile technique has been regarded as imperative. These attitudes are based on the blithe belief that if infection occurs it can be readily controlled by appropriate antibiotics. Such a position tends to blunt the surgical conscience of all who come in contact with the parturient.

HYPERTHYROIDISM

D. H. Solomon, MD FACP, et. al., Ann Intern Med 69(5:)1015–1035, Nov 1968.

The hypothesis that uncoupled or loosely coupled oxidative phosphorylation is a fundamental abnormality in hyperthyroidism is no longer tenable. Rather, mitochondria from hyperthyroid muscle are increased in number but normal in phosphorylative behavior. Sarcotubular vesicles are also increased in amount and appear normal in biochemical function. The cause of muscle weakness remains unknown.

The clinical features of hyperthyroidism are reviewed, with personal observations on their usefulness in diagnosis. The syndrome of Graves' disease is defined as a tri-system disease (thyroid, eye, and skin), and the autoimmune hypothesis of its origin is discussed in the light of the properties of the long-acting thyroid stimulator (LATS), an immunoglobulin unique to Graves' disease.

The choice of treatment of hyperthyroidism is still a matter for controversy. It is agreed that subtotal thyroidectomy, radioiodine, and antithyroid drugs, all have a role in treatment, but opinions differ on their comparative usefulness in various types of patients.

INCIDENCE OF PRIMARY ALDOSTERONISM UNCOMPLICATED "ESSENTIAL" HYPERTENSION

L. M. Fishman, MD, et. al., JAMA 205(7):497–502, Aug 12, 1968.

In a prospective study of the incidence of primary aldosteronism among patients with "essential" hypertension, this diagnosis could be excluded in 87 of 90 patients by the demonstration of normal aldosterone secretion or lack of suppression of plasma renin activity or both. In contrast, at least four of ten patients observed during the same period because of concomitant hypertension and unprovoked hypokalemia were proven to have primary aldosteronism. Primary aldosteronism is, thus, a relatively rare cause of hypertension among patients with normal serum potassium concentrations, but should be carefully considered as a possible cause of hypertension among patients with hypokalemia. Subnormal plasma renin activity was found to be a characteristic of patients with "essential" hypertension as a group; marked suppression of plasma renin activity was found in five (21%) of 24 patients with "essential" hypertension. Thus, although subnormal plasma renin activity can be used to distinguish primary from secondary aldosteronism, taken by itself, this finding is of limited value in diagnosis since it also occurs in many patients with "essential" hypertension.

RESEARCH SECTION

LIST OF RECENT PUBLICATIONS FROM RESEARCH LABORATORIES

The following papers have been completed by research activities under the direction of the Bureau of Medicine and Surgery.

Naval Aerospace Development Center:

"Dynamic Simulation of Spin on the Human Centrifuge, Report of Phase I," by E. I. Fessenden, R. A. Hall, and R. J. Crosbie. NADC–MF–6813, September 16, 1968.

"Review of the Dynamic Response Index," by G. H. Kydd and C. T. Reichwein. NADC–MR–6810, August 28, 1968.

Naval Aerospace Medical Institute:

"Effect of Water Immersion on Perception of the Oculogravic Illusion in Normal and Labyrinthine-Defective Subjects," by A. Graybiel, E. F. Miller II, B. D. Newsom, and R. S. Kennedy. *Acta oto-laryngologica,* Vol. 65, 1968.

"Functional Properties of the Descending Medial Longitudinal Fasciculus," by Bo E. Gernandt. *Experimental Neurology* 22(2), October 1968.

"Labyrinthine Defects as Shown by Ataxia and Caloric Tests," by Alfred R. Fregly and Ashton Graybiel. NASA Joint Report with NAMI, NAMI 994, August 1968.

"Manikin Measurements of the Noise Attenuation Provided by Flight Helmets," by John R. Forstall. NAMI–1049, August 1968.

"A Refined Thermodilution Cardiac Output Catheter," by Hassan H. Khalil. NAMI–1048, August 19, 1968.

Naval Medical Research Unit No. 2:

"Abstracts of Papers Presented by Staff of NAMRU–2 before the 60th Annual Meeting of the Formosan Medical Association, Taipei, November 11-12, 1967," *Journal of the Formosan Medical Association* 66(12), 1967.

Naval Medical Research Institute and Naval Medical Research Unit No. 3:

"Ticks (Ixodiodea) of Mt. Sontra, DaNang, Republic of Vietnam," by Harry Hoogstraal, Frederick Santana, and P. F. D. Van Peenen. *Annals of the Entomological Society of America* 61(3), May 1968.

Naval Dental Research Institute:

"Bromine in Parotid Saliva from Caries-Resistant Naval Recruits," by B. L. Lamberts, G. V. Alexander, and F. L. Losee. *Federation Proceedings* 27(2), April 1968.

"C-Reactive Protein and Peridontal Disease," by I. L. Shklair, R. H. Loving, O. F. Leberman, and C. F. Rau. *Journal of Peridontology,* Vol. 39, Mar 1968.

"Incidence of Potentially Cariogenic Streptococci in Caries-Resistant and Caries-Active Naval Personnel," by I. L. Shklair, A. L. Coykendall, P. B. Carroll, and H. D. Tow, Jr. Abstracts of 45th General Meeting of International Association for Dental Research, 1967.

"Isolation of Amylase from Human Parotid or Submaxillary Sublingual Saliva by Sephadex Gel Chromatography," by B. L. Lamberts, T. S. Meyer, and P. M. Osborne. 46th General Meeting of International Association for Dental Research, 1968.

"Phagocytosis of Cariogenic Streptococci by Caries-Free and Caries-Active Individuals," by I. L. Shklair and Gordon H. Rovelstad. Abstracts of 46th General Meeting of International Association for Dental Research, 1968.

"The Use of Wool Fast Blue BL for the Electrophoresis of Human Parotid Saliva Proteins in Acrylmide Gel," by T. S. Meyer and B. L. Lamberts. *Arch Oral Biol,* Vol. 13, 1968.

Naval Medical Neuropsychiatric Research Unit:

"Changes in Self-Reported Symptomotology During Recruit Training," by George A. Clum, John Plag, and Delbert Kole. *Proceedings,* 76th Annual Convention of the APA, 1968.

"Effects of Combat Duty on Ratings by Superior Officers," by George A. Clum. *Journal of Psychology,* Vol. 70, 1968.

"Fourteen and Six-Per-Second Positive Spikes in a Nonclinical Male Population," by M. T. Long and L. C. Johnson. *Neurology* 18(7), July 1968.

"Military Status and Mental Illness," by E. K. Gunderson, R. J. Arthur, and J. W. Richardson. *Military Medicine* 133(7), July 1968.

Naval Medical Research Institute:

"Determination of Association Constants for a Two-Solute System. I. Colligative Methods," by Robert F. Steiner. *Biochemistry* 7(6), June 1968.

"Domiciliary Reduviid Bugs and the Epidemiology of Chagas' Disease in Panama," by Alan C. Pipkin, Sr. *J Med Ent* F(1), February 25, 1968.

"A Guide to Insectivera and Dermoptera of South Vietnam," by Paul F. Ryan. *Formosan Science* 22(2), 1968.

"Hemorrhagic Shock in the Baboon I. Circulatory and Metabolic Effects of Dilutional Therapy, Preliminary Report," by G. S. Moss, H. J. Proctor, C. M. Herman, L. D. Homer, and B. D. Litt. *Journal of Trauma* 8(5), 1968.

"Hemorrhagic Shock in the Baboon II. Changes in Lung Compliance Associated with Hemorrhagic Shock and Resuscitation," by H. J. Proctor, G. S. Moss, L. D. Homer, and B. D. Litt. *Journal of Trauma* 8(5), 1968.

"The Luminescence of Tryptophan and Penylalanine Derivatives," by Ira Weinryb and Robert F. Steiner. *Biochemistry* 7(7), July 1968.

"Modified Model for the Mechanism of Freezing Injury in Erythrocytes," by H. T. Meryman. *Nature* 218(5139), April 27, 1968.

"Nutrient Media Storage of Human Bone Marrow," by V. P. Perry, A. M. Pappas, T. E. Wheeler, and C. E. Brodine. *Cryobiology* 4(4), 1968.

"Some Abnormal Permeability Characteristics of Ehrlich Ascites Tumor Cells," by L. A. Kiesow. *Zeitschrift fur Klinische Chemie und Klinische Biochemie* 6(4), June 1968.

"Treatment of Bends with Oxygen at High Pressure," by Robert D. Workman. *Aerospace Medicine* 39(10), October 1968.

Naval Radiological Defense Laboratory:

"Acute Mortality and Recovery Studies in Burros Irradiated with IMVP X-rays," by E. T. Still, N. P. Page, J. F. Taylor, W. G. Wisecup, E. J. Ainsworth, and G. F. Leong. NRDL–TR–68–101, September 5, 1968.

"Alteration of a Cat Small Intestine Mechano-Receptor Response by Ionizing Radiation," by R. E. Talbott, D. C. Jones, and D. J. Kimeldorf. NRDL–TR–68–99, September 3, 1968.

"Analysis of the Radiation-Induced Loss of Testes Weight in Terms of Stem Cell Survival," by J. S. Krebs. NRDL–TR–68–104, September 18, 1968.

"Bile Acids and Lipid Metabolism II. Essential Role of Bile Acids in Bile Phospholipid Excretion," by C. Entenman, R. J. Holloway, M. L. Albright, and G. F. Leong. NRDL–TR–68–102, September 16, 1968.

"Depolarization of the Neurally Blocked Gastric Mucosa of the Rat," by J. T. Cummins, B. E. Vaughan, R. L. Pessotti. NRDL–TR–68–105, September 23, 1968.

"Human Thyroid Dose from Milk of Cows Grazing on ^{131}L-Contaminated Pasturage," by R. W. Shnider. NRDL–TR–68–111, October 8, 1968.

"Mechanisms of Protection Against Gastrointestinal and Helatopoietic Radiation Lethality by Parabiosis," by H. W. Carroll and D. J. Kimeldorf. NRDL–TR–68–110, October 14, 1968.

"Separation of Amylolytic Fractions from Human Submaxillary Saliva and Serum by Acrylamide Gel Electrophoreses," by T. S. Meyer and B. L. Lamberts. Abstracts of 45th General Meeting of International Association for Dental Research, 1967.

"A Surfactant Bee Venom Fraction: Separation on a Newly Devised Constant-Flow-Rate Chromatographic Column and Detection by Changes Effluent Drop Volume," by W. H. Shipman and L. J. Cole. NRDL–TR–68–94, July 21, 1968.

"Susceptibility to Infection with Pasteurella Tularensis and the Immune Response of Mice Exposed to Continuous Low Dose Rate Gamma Radiation," by F. A. Hodge, W. R. Leif, and M. S. Silverman. NRDL–TR–68–85, August 7, 1968.

DENTAL SECTION

NAVAL ACADEMY PREVENTIVE PERIODONTIC PROGRAM UTILIZING AN ORAL PHYSIOTHERAPY CENTER

CDR J. Roy Elliott, DC USN.

Periodontal disease, the major cause of tooth loss in adults, commences in the teenage population as a seemingly innocuous gingivitis. This disease continues its destructive process into adulthood producing periodontal pocket formation and loose teeth from the ensuing bone loss.

A recent study at the Naval Academy corroborates other studies by showing the importance of preventing periodontal disease at an early age. When the Freshmen class of Midshipmen was given an oral examination, only 45 of the 1,277 examined were found free of any gingival inflammation. Of this same group, many were referred to a dental officer with training in periodontics because of the severity of their periodontal condition. Efforts to educate and motivate military personnel to acceptable oral hygiene practices via movies, lectures, etc., has been unsuccessful. Even though the neglect of oral hygiene lies frequently with dental practitioners, themselves, not being motivated to the philosophy of preventive periodontics, other blame lies with our current approach in educating and motivating patients to habitual and effective oral hygiene practices. The lack of preventing and/or treating the young military personnel creates insurmountable treatment problems arising predominantly in the over 30 age group. Approximately 65 Naval Dental Officers, on active duty, have received training in Periodontics to meet the ever increasing demand for periodontal treatment.

The only practical approach in reducing the incidence of periodontal disease among our military personnel lies in its prevention, early detection and treatment. Realizing this fact, RADM Frank M. Kyes, former Chief of the Dental Division, presented a new concept to the Navy Periodontics Workshop on April 3, 1967. This concept was the initiation of an Oral Physiotherapy Center (OPC) at the Naval Academy to reduce the incidence of periodontal disease among Midshipmen. The Center was designed by CDR Gerald M. Bowers, DC USN in 1967 and construction was completed in January 1969.

The purpose of the Center is to educate and motivate *all* Midshipmen to achieve and maintain optimum oral health. While many local and systemic factors play a role in the initiation and progression of periodontal disease, bacterial plaque is paramount as the major offender. Many studies have reported a direct correlation between dental plaque, with its teeming microorganisms, and gingivitis, periodontitis, and bone destruction. The Midshipmen are taught in the Center to completely remove all bacterial plaque from tooth surfaces. Learning and practicing the necessary cleansing procedures serves as self treatment and/or preventive measures.

Physical Structure of the OPC

The OPC is located adjacent to the periodontics operatories of the Dental Department in Bancroft Hall. The Center is equipped with six individual units or booths to accommodate six subjects at a time for the practice cleansing sessions. Each unit, separated by a partition, is equipped with: a sink providing hot and cold water, a large mirror with fluorescent lights on either side, a cup and towel dispenser, and oral physiotherapy devices. An adjustable stool, with back support, and head rest permit oral examinations to determine the subject's progress.

Method of Operation

The Center is presently operated in the following manner:

1. Six Midshipmen with an established gingivitis (a polarized group) receive a one-hour appointment.
2. Following a briefing, the men are made aware of their common condition which will eventually cause the loss of their teeth unless they take immediate action.
3. Using various training aids, an illustrated presentation on periodontal disease is given. Emphasis is placed on how insidiously a gingivitis progresses to periodontitis resulting in tooth loss.
4. Bacterial plaque is vividly portrayed through: the utilization of photographic aids, the patients own plaque as revealed by disclosing solution, and phase contrast microscopy. When the subjects view their own bacterial plaque via a 23″ television monitor, it seems to serve as an invaluable motivational tool.

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Department of the Navy or the Navy Dental Corps.

5. The participation phase now begins as the subjects become involved in their own treatment. Explicit instructions relative to the proper use of selected cleansing devices is given. These devices, and their proper use, were determined from previous studies. Disclosing solutions and tablets are used to motivate and assist the subjects in the complete visual removal of bacterial plaque. Plaque disclosing aids also permit a quantitative assessment for recording the patients progress.

6. Following the subject's attempt to remove bacterial plaque, an examination of residual plaque is done to provide individual supervision and instruction for the patient.

7. Midshipmen not possessing the necessary cleansing devices are loaned these items to establish the cleansing habit. Incoming Freshmen receive the recommended cleansing devices along with other personal items in an "issued kit" at a reduced cost. The Midshipmen's store makes available American Dental Association approved dentifices and only those cleansing devices recommended by the Dental Department.

8. The Midshipmen are appointed weekly for the motivational and educational sessions until each has mastered the effective use of oral hygiene devices to maintain optimum oral health.

Oral physiotherapy instructions given during the cleansing sessions need reinforcement by the dental officer and auxiliary personnel during subsequent oral examinations and dental appointments. While studies are presently underway to determine short and long range effectiveness of the OPC, a pilot study has shown that Midshipmen, with a gingivitis, can be educated and motivated effectively on a group basis.

Some of the benefits and advantages of the OPC are:

1. Emphasis is on small groups and return sessions to evaluate the effectiveness of patient efforts and to give reinforcement.

2. By using training aids, such as video tape recordings, for the educational and motivational presentations, it is hoped that auxiliary personnel may effectively operate the Center thus freeing the dental officer for more definitive type treatment.

3. The taped presentation could be put on film for use throughout the Navy and Marine Corps thus providing a superior and uniform method of oral physiotherapy instructions.

4. The Center offers a tool for research where change can be instituted as needed. An available group for 4 years at the Naval Academy permits both short and long range studies.

5. Psychologists claim a polarized group is more receptive than on an individual basis. In addition, the Center permits individual instruction and supervision as needed.

6. If patient progress is maintained following OPC participation, the long range benefits would be phenomenal in reducing tooth loss from periodontitis and dental decay.

7. It is believed that these future officers, having understood the value of self care, would more effectively contribute to a Preventive Dentistry Program throughout the service.

Summary

Practically all young adults entering the military already have the first stage of a disease process that is the primary cause of adult tooth loss. Conventional means of motivating these patients to effective oral hygiene practices has been disappointing.

In recognition of the need for an effective preventive periodontics program for the Navy, a new concept, the Oral Physiotherapy Center, was initiated at the Naval Academy. The Center provides a means of orienting groups of patients in the involvement of their own treatment following an educational and motivational presentation. Following this procedure, utilizing audio-visual and other communicative aids, patients practice oral physiotherapy procedures using the facilities of the self treatment units. The patients return for a sufficient number of oral hygiene sessions until each has demonstrated effective and habitual oral hygiene practices.

WHAT SHOULD BE THE DENTIST'S ATTITUDE TOWARD CIGARETTES?

Editorial, Dent Abs 14(1):9, Jan 1969.

Twenty years of research—laboratory, clinical and epidemiological—has made it apparent that the smoking of cigarettes, as well as of pipes and cigars, is related to the development of oral cancer and other abnormalities of the oral tissues.

The dentist should inform himself about the relation of smoking to disease and death. Though the oral cavity is his primary responsibility, the dentist is a health professional and can be an important figure of authority on general health matters. The dentist who speaks of smoking's effect on oral tissues must acquire a knowledge of smoking's broader effects so that he can better respond to the questions of his patients.

The dentist should discuss smoking with each patient. Only dentists and physicians, of all the

health professionals, are in a position to influence the community health in the oldest and most valuable health education situation, the doctor-patient relationship. The dentist is in a favored position because his patients are more likely to see him regularly over a period of years while they are well and, therefore, more emotionally receptive to learning and to changing their attitudes.

The dentist should be prepared to assist the patient who is attempting to quit smoking, just as the dentist assists his patient in adopting other regimens which aim to improve oral health.

The dentist should be aware of the continual pressures faced by the nonsmoker to begin smoking, especially among young people. A simple expression of support and congratulations to the nonsmoker may be of timely importance as a reinforcement for his abstinence.

The dentist should critically examine his own smoking behavior. Because he symbolizes health authority and acts to influence individual and community attitudes, the dentist must consider his role as an exemplar to the community.

The dentist should avoid evangelizing. Smoking is a behavior with deep psychological roots and social utility; moral diatribes may do more harm than good. The dentist is not a moral arbiter, he is a scientific health authority. A brief statement to the patient about the dentist's conclusion that smoking is an extremely dangerous practice may be the most acceptable beginning.

The dentist should have realistic expectations about his effectiveness as an educator. Health and educational agencies have made concerted national efforts over the last five years to reduce tobacco smoking. Though small, the measurable effects of these efforts have been encouraging. But this success was not the work of any one agency, individual, or program. Continued success requires that all elements in the health education process act in concert. Working with all the other community health forces, the dentist has an integral role in the subtle stimulation and reinforcement of changes in community smoking practices.

The dentist should not assume the total burden. Prevention is the patient's responsibility as well as the dentist's. Prevention becomes the patient's responsibility after the dentist informs himself about the relation between smoking and ill health communicates his conclusions and suggestions to the patient, and offers sympathetic assistance.

(By John M. Weir, MA, Director, Smoking and Health Project, American Dental Association.)

EFFICACY OF A PORTABLE ETHYLENE OXIDE STERILIZING UNIT

LCDR J. "J" Rudolph, DC USN, and CDR W. C. Sullivan, DC USN.

Sterile instruments are needed for most dental procedures, but ordinary sterilizing apparatus cannot be used without supplies of electricity and live steam. There is, therefore, a particular need for an efficient portable sterilizer for use in military emergencies. The purpose of our study was to evaluate a sterilizing procedure that uses ethylene oxide in small, air-tight containers. Containers with a 200-cc capacity were made by sealing 8-inch lengths of tubular aluminum at one end and closing the other end with a threaded brass cap fitted with a neoprene gasket. A total of 20 tests were made, and three containers were used in each test. Instruments seeded with *Bacillus subtilis* spores were air dried, placed in nylon bags, and inserted into the containers. A liquid mixture of 11 percent ethylene oxide in inert material (Cry-Oxcide) was introduced into one bag to give a concentration of 1 mg/cc volume, and the bag was sealed with a rubber band. Two containers, one with ethylene oxide and one without, were immersed in boiling water to determine the effect of elevated temperature on sterilizing time; the third container was kept at room temperature and used as a control. After intervals of 10, 15, and 30 minutes, the instruments were removed and tested for sterility. In containers with ethylene oxide, the number of organisms was considerably reduced in 10 minutes, and sterility was achieved in all 15- and 30-minute tests. Sterility was not achieved at any time interval in any container without ethylene oxide, whether the container was boiled or kept at room temperature. In one container with ethylene oxide but kept at room temperature, sterility was not achieved even after 60 minutes. It was concluded that a small, air-tight tube that contains a 1 mg/cc concentration of ethylene oxide and is heated to the temperature of boiling water can be used effectively in emergencies to sterilize small instruments in 15 minutes.

(Abstract by Research Work Unit: MR005.19–6052 by LCDR J. "J" Rudolph, DC USN, and CDR W. C. Sullivan, DC USN.)

The opinions and assertions contained herein are those of the authors and are not to be construed as reflecting the views of the Navy Department or the naval service at large.

DIAGNOSTIC SEQUENCE FOR JAW LESIONS

L. Rex Collins, Jr., Raymond P. White, Jr., and S. Elmer Bear, J Oral Surg 26(11):696–701, Nov 1968.

An orderly diagnostic sequence is suggested before lytic jaw lesions are treated to avoid unexpected severe hemorrhage from such highly vascular lesions such as central hemangioma and arteriovenous fistula.

Three techniques (1) analysis of the aspirated contents of the lesion, (2) needle biopsy, (3) and arteriography are part of the sequence as well as routine physical examination and laboratory studies.

Aspiration may be carried out with a 20 cubic centimeter Luer-Lok syringe and an 18 gauge needle. In a vascular lesion, blood will rapidly fill the syringe and the hemoglobin or hematocrit may be compared with a sample of the patient's venous blood.

Needle biopsy with a 14 gauge Silverman needle may be substituted for an open biopsy for lytic lesions when positive aspiration of blood contraindicates open biopsy. Puncture site bleeding may be controlled by pressure as in the needle aspiration.

Angiography can be used to determine the vascular pattern of the lesion when suspicion of a vascular lesion persists. Percutaneous injection of dye material into the carotid artery or selectively into the external carotid systems while obtaining serial radiographs helps to identify vascular malformations.

A case report was presented to illustrate the value of these tests.

(Abstracted by CAPT Howard S. Kramer, Jr., DC USN).

ORAL ASPECTS OF PERNICIOUS ANEMIA

Erik Hjorting-Hansen and Ulrik Bertram, Brit Dent J 125(6):266–271, Sept 1968.

Pernicious anemia is a macrocytic anemia with frequent oral changes. Four patients, 3 females and 1 male, are discussed. In all a tentative diagnosis of pernicious anemia was made on the basis of the oral changes which consisted of atrophy of the papillae of the dorsum of the tongue, irregular enanthema of the buccal mucosa, burning and itching sensations, disturbances in taste and lobulation of the dorsum of the tongue. All but one had a low serum vitamin B_{12} value and moderate to marked anemia. All patients were treated with vitamin B_{12} by injection and within weeks after the start of treatment all oral symptoms and signs disappeared. The importance of a thorough medical examination in a patient with mucosal atrophy of the tongue and atypical sensations in the oral cavity is emphasized.

(Abstracted by CAPT George H. Green, DC USN.)

COUNCIL ADOPTS AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 18 (ALGINATE IMPRESSION MATERIAL)

Council on Dental Materials and Devices, JADA 77(6):1354–1358, Dec 1968.

This first revision of specification No. 18, effective in May 1969, replaces the original (1964) specification for a dental impression material in powder form containing an alginate as the gel-forming ingredient. Two types are specified: Type I, fast setting (working time not less than 1¼ minutes, total setting time not less than 1 or more than 2 minutes), and Type II, normal setting (working time not less than 2 minutes, total setting time not less than 2 or more than 4½ minutes).

The revision has deleted the original requirements and tests for fineness of the powder and for the material's elasticity, as determined by ability to receive an impression of a specified metal model without rupturing. In the test to ascertain that permanent deformation is not more than 3%, the fixed strain applied has been reduced from 12 to 10%. The strain in compression has been changed from a minimum of 4% to a minimum of 10% under the specified conditions of testing. Finally, a revision in the requirement that the material be compatible with and separate cleanly from a gypsum cast specifies that the cast surface be not only smooth but also non-chalky.

Other special requirements remain unchanged. The material must be free of foreign material and of any unpleasant odor or flavor. At the time of certification, the manufacturer must furnish a statement that the material does not normally irritate oral tissues and does not contain poisonous ingredients in a concentration that would be harmful to humans when used as directed or in the event as much as 10 ml should be accidentally ingested. Requirements and tests for uniformity, for compressive strength, and for freedom from deterioration in storage are also specified, as is the preparation of the material for delivery, which includes packaging and marking of containers and instructions for use.

(Abstracted by CAPT Nelson W. Rupp, DC USN.)

PERSONNEL AND PROFESSIONAL NOTES

DENTAL HEALTH EDUCATION AND PREVENTIVE DENTISTRY

For too long we have assumed that patients understand the aims of our treatment procedures. Yet the very opposite is more often true.

A recent study[1] to determine the acceptance of the three-agent stannous fluoride treatment reenforces the former statement. In Table IV of the study, they report the responses to the question:

What good do you think the treatment did?

Did no good	7 (2%)
Gives me strong teeth	17 (4%)
Helps prevent decay	141 (35%)
Gives me strong gums	29 (7%)
Don't know	205 (50%)
No response	6 (2%)
Total	405 responses

Sixty-one percent of the respondents gave responses that were either unfavorable, incorrect, did not respond or did not know why the treatment was given. It is obvious that the subjects of this study were recipients of an ineffective educational effort as related to the value of stannous fluoride therapy.

Health educators are coming to the realization that well-planned and effective educational programs for health are in direct proportion to the number of programs which have well-planned and effective evaluation procedures as part of the program.

Have you evaluated your dental health education program in the past six months?

Is your program effective?

CASUALTY TREATMENT TRAINING COURSE JANUARY 1969

Twenty dental officers of the U.S. Navy completed the Casualty Treatment Training Course at the Naval Dental Clinic, Norfolk, Virginia. The Course, under the supervision of the Bureau of Medicine and Surgery, is conducted throughout the Navy to develop in dental officers such skills in emergency casualty treatment as to make full use of their professional knowledge, thus enabling them to amplify the medical effort in time of major emergency. This is the first course to be conducted here this year. Similar courses are held at Bethesda, Maryland; Great Lakes, Illinois; and San Diego, California. Attending the Course here were: CAPT Charles F. Rau, DC USN; CAPT John B. Halet, DC USNR–R; CDR Russell A. Grandich, DC USN; LCDR George F. Niesar, DC USN; LCDR Alan G. Sirmans, DC USN; LCDR Jacob Geller, DC USNR–R; LT Joel E. Leizer, DC USNR; LT Walter G. Crooks, DC USNR; LT Andrew C. Stutz, DC USNR; LT Peter G. Sorvas, DC USNR; LT William M. Novince, Jr., DC USNR; LT Jack W. Groover, Jr., DC USNR; LT Harold C. Stone, DC USNR; LT Jerald O. Workman, DC USNR; LT Charles O. Boyd, DC USNR; LT Robert L. Foster, DC USNR–R; LT Edward L. Acree, DC USN; LT Barrett M. Hunter, DC USNR; LT Roger L. Colebrook, DC USNR; LT Eric T. Helland, DC USN.

The Casualty Treatment Training Course was under the direction of CAPT W. B. Gregory, DC USN. RADM M. E. Simpson, DC USN, is Commanding Officer of the Naval Dental Clinic, Norfolk. CAPT J. F. Link, DC, USN, is Executive Officer.

JOINT DENTAL MEETING

Dental Officers of the Naval Submarine Base New London, Groton, Connecticut, were hosts at a joint meeting with the New London County Dental Society in January 1969. Prior to the dinner meeting a tour of the dental facilities included prosthetic clinics by CAPT D. R. Bassett and CDR J. A. Bodner. CAPT S. D. Cunningham, Senior Dental Officer, welcomed the Society to the Submarine Base. A paper with slide illustrations titled "Morphological Characteristics of Plaque Components" was presented by CDR W. R. Shiller, of the Dental Research Branch, Submarine Medical Center, and LCDR Rodman Brokaw, of the Base Dental Department. As an additional feature, a phase microscope set up and connected to a closed circuit T. V. proved especially interesting to Periodontists of the local Dental Society.

COURSE CANCELLATION

The postgraduate course "Command Leadership in Interpersonal Relations," scheduled for 28-30 April 1969 at the Naval Dental Center, San Diego, California, as part of the U.S. Naval Dental Corps Continuing Education Program, is canceled.

[1] Shiller, W. R. and Scola, F. P., Subject Acceptance of Stannous Fluoride Treatment. Memorandum Report No. 68-9. Naval Submarine Medical Center Submarine Base, Groton, Connecticut.

NURSE CORPS SECTION

AN EFFORT TOWARD UNDERSTANDING

The following article, based on personal experience, was written by ENS Susan Green, NC USNR while a student at Columbia University. Miss Green is currently on the Nursing Service Staff at the Naval Hospital, San Diego, California.

The evaluation of indices of growth in interpersonal relationships challenges the nursing student to an introspective examination of herself and the components which interplay in her interactions with patients. Each response which she gives, whether verbal or nonverbal, is a reflection of her professional maturation and the resulting product of her self-actualization. Her response as a nurse is the culmination of her varied life experiences, feelings, and attitudes and of the means she uses to handle them. As a nurse, when she is faced with the vulnerabilities of others, she comes face to face with her own vulnerabilities and through their constructive resolution, she begins to realize what it means to be a human being and is gradually able to accept her own humanity.

In establishing a good interpersonal relation with a patient, intellectual and emotional acceptance of the patient is not only a desirable, but a necessary prerequisite to an attempt to full understanding of the patient. John, a twenty-one year old quadraplegic receiving rehabilitative medicine in the Neurological Institute presented a challenge, one from which I developed as a person. In the utmost of optimism, with an acute awareness of the need for emotional expression that a long term patient such as John will have, I approached him with the intention of discussing his feelings about his diving accident and the implications of his condition on his future. I soon found out that good communication is not inevitable, even with the noblest of intentions. But why? After experiencing the frustrations of not really being able to communicate with him, I stopped to evaluate the blocks in communication. What were they? How did they interfere? What was I missing? And perhaps most important, what could I do about the problem?

I soon realized that I was overwhelmed with John's physical picture, that of a dependent, paralyzed young man with clonic spasms. The similarity of our ages and my identification with him were probably factors that hindered communication. I was so overwhelmed by his physical condition that "the person" beneath was clouded from my vision. Therefore, I was rather naive to assume that I would be able to talk with him about his feelings.

What was my previous approach, and why had it proved ineffective? While standing at the bedside, probably shifting weight from foot to foot, I told him the proverbial nurse's adage "I understand how you feel." How many times have we said this as nurses? His response to my statement was an intellectual summary of his feelings, and my response was similarly intellectual. Intellectualization was our common approach and both of us were somewhat comfortable with this approach since it lacked emotional involvement.

At this point I suddenly realized the lack of growth in our relationship and its superficial nature. My saying that "I understand" and my intellectual approach offered security, my defense against a situation in which I felt uncomfortable. After realization of the factors which contributed to limitation in our relationship, I was able to change my approach. As I approached his bedside, I pulled up a chair; he followed my actions with his eyes. The following conversation ensued:

Nurse: John, I've told you many times that I understand how you feel lying in this bed. But you know something? John, I really don't know how *you* feel.

John: I am so sick and tired of nurses telling me that they understand. How can they? Here I lie, nurses attending to all my physical needs. I'm helpless. I'm a twenty-one year old man with nothing left. Sometimes I think it's useless to go to physical therapy. I don't think I'll ever get better. But I fool everyone with a smile. I'm so scared. I'll tell you how it feels. . . .

John expanded on his feelings of helplessness, and as he talked, I felt a closeness with him, perhaps empathy and an understanding which I had never experienced before. I felt a genuine warmth and concern for his welfare and a desire to help to alleviate his distress. This empathy for another human being is expressed in verbal and nonverbal terms; it is an expression of love for a fellow human being. My concern, in an effort to sustain, support, and encourage, imparts a confidence and assurance that John will reach his optimal, that I will help him, and that he is not alone. This was conveyed through

my accepting attitude and my willingness to try to understand him. My honesty with him led to the beginning of an understanding of his situation. After working with him for many days, I began to see the person inside the disability. He felt my sincerity, and our conversations, which were previously intellectual, superficial, and light, became a source of honest communication. His feelings were accepted as a part of him.

How can this situation relate to other nurses? Of cardinal significance in the evaluation of one's interpersonal relationships is the question, "How do I define nursing?" I see nursing as a process by which I can help people to prevent or, if this fails, to cope with the experience of illness, and if possible, to find meaning through the experience, and thus grow myself as a human being. But what is the practical application of this general definition that is probably accepted but seemingly often not practiced by some nurses? Perhaps this is the crux that leads to differences between nurses that gives them their individual approach. If nursing is an "interpersonal process" as previously mentioned, what is the relationship between the nurse and patient? What is its function? How does the relationship mature to therapeutic value?

In my relationship with John, I found that it was the previously mentioned empathy or compassion for him that permitted me to transcend beyond and outside of myself in order to perceive and respond to him as an individual. I interacted with John in a genuine sincerity as a nurse and as a human being, not merely as the former which carries the facade of role, title, position, and status. It is the realization and acceptance of humanness of the self which precedes acceptance of others as human beings.[1] Seen solely as a patient with physiological malfunction, it becomes easy for the nurse to omit the individual and concentrate on a wound, dressing, and sterile procedure. But seen as a human being with innate dignity and individuality, the relationship becomes an interpersonal one and true communication is facilitated. The maturation or ripening of the self in interpersonal relationships is not inevitable with nursing; however, its prerequisite is inevitably a love for a fellow human being which gives him worth and respect. Through this, the nurse is acutely sensitive to needs, and understands without prejudice.

Perhaps the best criterion for establishment of growth is the delineation of personal satisfactions in nursing. Much of my satisfaction in working with John relates to an inner sense of accomplishment that I felt as I worked with him in gaining insight and awareness of his feelings and making him more aware of them so that he could work through and with these feelings which ultimately effect the success with which he is able to learn to live with his limitations. This cannot be seen as a tangible day by day occurrence in which there is an overt result, but over the weeks, as a change in attitude, in this case as an accepting attitude which facilitated his *wanting* to get better. Indices of his change in attitude were manifested by everything from persistence in trying to open a milk container to an increased effort at physical therapy.

By helping another individual to gain insight into his feelings, I am able to better understand myself and others, and through this and the realization of my own vulnerabilities, I grow as a person. Each situation presents a new opportunity for growth as I am challenged; growth is a continuous and changing process. Nursing will never be in danger of being replaced by automated robots with cold glassy eyes as long as the nurse remains compassionate. The *person* in her need not be mechanized nor should it ever be. A machine cannot love, and it is this quality, and perhaps this quality alone, that dynamically separates nurses from machines. . . . A nurse can have compassion.

[1] Travelbee, Joyce. *Interpersonal Aspects of Nursing.* Philadelphia: F. A. Davis Company, 1966, p. 46.

PREVENTIVE MEDICINE SECTION

COMPARING MANTOUX AND JET-INJECTION METHODS OF TUBERCULIN SKIN TESTING

E. Feigenbaum, Ann Cherney, E. Spradlin, and A. Fry, USDHEW PHS Public Health Rep 83(11):974–978, Nov 1968.

The Ministry of Health of Vietnam has been surveying the 15 million people of that nation to detect cases of tuberculosis. Both the World Health Organization (WHO) and the U.S. Agency for International Development have provided assistance in this effort. At present, Mantoux tuberculin tests are

administered, nonreactors receive Bacille Calmette Guerin (BCG) vaccine, and "positive" reactors are given X-ray examinations. Persons with subsequently diagnosed tuberculosis are treated.

The introduction of jet-injection equipment to the public health effort in Vietnam has made possible a new intradermal injection technique. Because of a shortage of medical and paramedical manpower, it was postulated that intradermal tuberculin skin testing by jet injection might expedite mass surveys through the utilization of existing personnel. To determine the effectiveness of testing for tuberculosis by jet injector as compared with the Mantoux technique, a study population of 1,478 inmates of the National Mental Hospital, Bien Hoa, Vietnam was used.

Inmates of the hospital, ranging from 8 years to over 70 years, were given tuberculin by both methods. Tuberculin skin testing had never been performed within the institution before this trial, and the past medical history of the patients was unknown, although the hospital director felt that pulmonary tuberculosis was a major disease among his patients. History of BCG immunization preceding commitment to the hospital was not available.

Primary objective was to compare results of skin test readings after mechanical injection of tuberculin antigens with those after use of needle and syringe (Mantoux method) on the same patient. If skin test readings after jet injection were discovered to be equivalent to Mantoux test results, further investigations concerning speed of administration and survey campaign organization were to be undertaken.

Procedure

A foot-powered jet-injection apparatus was used in this test. Electrical power might not always be available in the field for use of an electrically operated unit.

Mantoux skin tests were administered with disposable syringes. The ventral surface of one forearm was punctured by needle for the tuberculin; tuberculin by jet injection was placed on the ventral surface of the patient's other forearm. Each syringe was filled with an individual dose of 0.1 ml and was discarded after use. The jet apparatus was set to dispense 0.12 ml. On each day of testing it was calibrated before use as suggested by the manufacturer.

The tuberculin used, PPD RT–23 with Tween 80, was diluted to 1 TU per 0.1 ml dose and packaged in 50 ml rubber-stoppered vaccine vials for both jet injection and syringe administration. All tuberculin was from the same lot of concentrate supplied by WHO and diluted by Pasteur Institutes, Vietnam, for use in the test.

The entire survey was completed in 4 working days. Tests were given on Monday and Tuesday, followed by readings 72 hours later on Thursday and Friday of the same week. Patients from the 18 wards of the hospital were divided into 2 working days for both testing and reading that had been followed in giving the tests.

Mantoux syringe-needle tests were administered by one nurse detailed from the Hong Bang National Tuberculosis Hospital staff who had had many years of experience with this technique. Jet-injector tests were administered by one nurse employed by the U.S. Agency for International Development who had had 1 year of experience using hypodermic jet equipment. Although each patient received tuberculin antigen intradermally in both forearms, the right arm-left arm distribution of needle or jet techniques was varied from ward to ward and noted.

One additional nurse provided by the national tuberculosis hospital read the resulting reactions 72 hours after administration. She had had many years experience doing this work, was not present during injection days, and was not aware which arm represented a Mantoux or jet test in any given patient. Procedural protocol was supervised by both Vietnamese and American medical personnel. WHO criteria for administration and reading of intradermal tuberculin tests were adhered to at all times.

Results

Fifteen patients had greater reactions to jet-administered tuberculin when compared with their response to Mantoux technique. Only 133 patients had no reaction to needle testing, although 326 were nonreactive to jet-injected antigen.

In applying the WHO criteria of 8 to 10 mm of induration for the interpretation of reactions as positive, the upper size of 10 mm has been in common use in Vietnam for the ITU skin tests employing RT–23 with Tween 80. Using the index of 10 mm as the dividing line between positive and negative reactors, 179 patients were tuberculin negative in the needle-syringe group, and all but 2 of those were negative to the jet injector. However, an additional 607 were also negative by jet injector; these were considered "false negatives." In other words, 607 of 784, or about ¾ of the reactions called "negative" by jet injection, were "positive" by Mantoux.

Discussion

The reaction caused by 0.1 ml of tuberculin antigen deposited intradermally should not vary if WHO criteria for positivity are to be used.

Forearm girth, skinfold thickness, and operator experience were also reported as not affecting reaction size. Race and age are suggested as being pertinent, but it is postulated that some factor inherent in the way antigen is deposited by the jet injector is probably more important in determining reaction size. In this series of 1,478 patients, no evaluation of antigen deposition was attempted beyond checking to see if a visually satisfactory wheal was produced by both techniques on each person tested.

In analyzing data it was noted that resulting indurations after jet injection of tuberculin antigen tended to be smaller than those produced by Mantoux tests.

Conclusions

The impression is that hypodermic-jet intradermal tuberculin skin testing using the equipment described is not sufficiently sensitive, when compared with standard needle-syringe techniques, to warrant its use in mass surveys of populations, whether the screenees have high or low positivity rates. Some 77% false negatives by jet injection is too large an error to be acceptable. Additional investigation of intradermal deposition of fluids by jet injection, both quantitatively as well as of penetration, spread, and local reaction are suggested.

Summary

Results of intradermal tuberculin skin tests using hypodermic jet equipment were compared with results obtained by the standard Mantoux needle-syringe technique in a study of 1,478 Vietnamese mental patients suspected of having a high prevalence of tuberculosis. If intradermal tuberculin skin test readings after jet injection were discovered to be equivalent to Mantoux test results, mass testing for tuberculosis would be expedited through more efficient use of existing medical and paramedical personnel.

A foot-powered jet-injection apparatus, disposable syringes and needles, and tuberculin, PPD RT–23 with Tween 80 diluted to 1 TU per 0.1 ml dose, and the jet apparatus was set to dispense 0.12 ml. On each day of testing the hypodermic jet was calibrated to actual quantity delivered before being used, as suggested by the manufacturer.

One nurse used the needle-syringe method, and a second nurse used the jet injector to administer the test. The right arm-left arm distribution varied from ward to ward, and patients in all 18 wards of the hospital were given tests in a 2-day period. A third nurse spent 2 days reading the reactions 72 hours later.

World Health Organization criteria of 8 to 10 mm of induration for the determination of positive reactors were used, and procedural protocol was supervised by representatives from both Vietnamese and American medical personnel.

Using 10 mm of induration as the lower limit of positivity, 177 patients were tuberculin negative by the Mantoux technique, and 607 were negative to jet-injected antigen. This number represents a false negativity rate of 77% among tests by jet injection. A total of 326 tests by jet injection were completely nonreactive, while 133 were nonreactive to Mantoux testing. This discrepancy obviates any possible revision of criteria for positivity to compensate for the generally smaller reactions found by others, as well as ourselves, to the jet-injection method of tuberculin skin testing.

Hypodermic-jet intradermal tuberculin skin tests with the equipment used in the study did not seem sufficiently sensitive, when compared with standard needle-syringe techniques, to warrant its use in mass surveys of populations with high rates of tuberculosis.

MAN AND HIS ANIMALS

Los Angeles Co Health Dept, Morb & Mort Rep Dis, Wk Ending Dec 7, 1968.

In the middle of the Miocene when the anthropoid and pre-human lines diverged, man descended from the trees, probably bringing with him a heritage of lice, pinworms and malaria which he had acquired from his primate associates.

The transition from an arboreal to a terrestrial environment brought early man into contact with new species of animals. Gradually, he came to rely on these animals for protection, food and companionship and he found it advantageous to domesticate certain species. Because he was a primitive, he was susceptible to a wide variety of organisms indigenous in the aboriginal fauna.

The existence of early religious laws relating to the handling and slaughtering of animals suggests that man has long recognized the association between some of his own diseases and those of animals and that he believed that steps could be taken to control their spread. Progress beyond this stage was slow until the invention of the microscope many centuries later made it possible to identify the etiological

agents responsible for such diseases. Today, many of the organisms have been identified and their methods of transmission determined; but our understanding of the mechanisms of host specificity and pathogenicity is still not far removed from the primitive stage.

In a recently published book, "Diseases of Man Acquired from His Pets," Dr. B. Bisseru presents a full description of the animal diseases commonly transmissible to man as well as a description of many that are rare and others that are hypothetical. His interpretation of the word "pet" is broad and includes creatures with whom man usually has only casual contact.

It is probable that all human diseases were originally zoonoses. With evolution, man developed a complete immunity to some of the animal diseases; the animals in turn developed a complete immunity to some of the human diseases; and some of the diseases became less virulent to man because through a slow process of adaptation he was better able to tolerate them. In general, the longer that he has been associated with a particular animal and its infectious diseases, the less likely is he to have serious consequences from these diseases.

There are at least 100 diseases and an even greater number of parasites that affect both man and animals. Some of these are cosmopolitan in distribution, a few are peculiar to the temperate zone, but the majority are limited to tropical areas, where they cause inestimable human suffering. With a few exceptions, the risk and consequences from the zoonoses in North America are much less serious than they are from the zoonoses in other parts of the world.

Ringworm, cowpox, cat-scratch disease and numerous ectoparasites may be spread by direct contact with living animals. Contact with dead animals and animal products may result in such diseases as anthrax, brucellosis and tularemia. Animal products which are used as food may produce trichinosis, brucellosis, bovine tuberculosis and infestation with tapeworms and trematodes. In civilized societies these diseases are largely controlled by inspection of meat, pasteurization of milk, and by our preferences for cooked rather than raw animal products.

Animal hosts are the reservoirs of several agents which may be transmitted to man. The salmonellas, the infective stages of many parasites, hydatid cysts and *Toxocara* larvae, are spread by fecal contamination; leptospira from rodents or dogs with leptospirosis are spread by urinary contamination; rabies virus is spread by salivary contamination; arboviruses, rickettsiae, the pasteurellae of plague and tularemia, and blood protozoa are spread by blood-sucking arthropods.

The recent trend in North America to adopt wild and exotic creatures again places man in the position he occupied when he gave up his arboreal life and descended to the ground; he is coming into contact with new diseases against which he has had no opportunity to build up any defense or develop any tolerance. If the exotic creature is acquired as a status symbol, the owner may also achieve the unenviable additional distinction of being the first to suffer from some exotic disease. When a patient has a disease of unknown etiology, the physician would do well to inquire about where he has travelled and what pets he has.

As far as disease is concerned, exotic animals that have been bred in captivity are much safer. Imported wild animals may be infected with or carriers of new and unknown viruses or protozoa or worms which as larvae are able to live in man. Monkeys, one of the favorite exotic pets, may harbor viruses; they frequently have tuberculosis; and they may carry amoebae which can cause dysentery in humans. Rodents such as gerbils, hamsters and mice are also popular and they may have salmonellosis, leptospirosis or tapeworms. Imported birds may have ornithosis or histoplasmosis; on occasion even domestically reared birds have been carriers of these diseases. In addition to exposing themselves to disease, owners of exotic animals also expose themselves to the risk of injury because they are not properly trained or equipped to feed and handle these creatures.

Contact with our native animals in their natural habitat is usually limited, but it must be remembered that the increasing popularity of our national parks is bringing more people into contact with wild animals and thereby exposing them to new risks. Any wild animal that is not apprehensive of man is likely sick and should not be approached or handled. Skunks, raccoons, foxes and bats whose behavior is unusual must be suspected of having rabies. Rabbits may have tularemia or listeriosis. In some areas of America, prairie dogs and other rodents may be the source of plague.

Although man is still the source of most of his own infectious diseases, he has by no means reached a state of complete immunity to the diseases of those other creatures that share the planet with him. Until such a time is reached, the zoonoses must not be regarded only with academic interest but must be given attention their increasing important merits.

MENINGOCOCCAL INFECTIONS

USDHEW PHS NCDC Morb & Mort Wkly Rep 18(5):38–39, Feb 1, 1969.

In 1968, 2,524 meningococcal infections were reported to the NCDC, Atlanta, Ga., for annual rate of 1.27 cases per 100,000 population. The number of cases increased 16% over the 2,164 cases reported in 1967 (annual rate of 1.10), while the 1968 rate was lower than the mean rate of 1.34 for the 8 years 1960-1967. Military cases comprised 8.3% of the 1968 total compared with 6.1 and 9.8% in 1967 and 1966, respectively. There was no significant change in the pattern of reporting from the 9 U.S. geographic divisions with only the Pacific Division reporting fewer meningococcal infections in 1968 than in 1967.

The peak incidence occurred in February of the epidemiologic year 1967-68 which is earlier than the mean peak for the years 1960-67. The incidence of meningococcal infections in the United States for each of the first 4 months (Sept-Dec) of the current epidemiologic year, closely parallels that of the preceding year.

Serogroups B and C were the predominant isolates of the 519 isolates of *Neisseria meningitidis* from blood or cerebrospinal fluid submitted to NCDC for serogrouping or sulfonamide sensitivity testing in 1968. The percentage of serogroup C isolates was approximately twice that of 1967 and 3 times that of 1966, while serogroup B strains declined from 70.6 in 1966 to 47.4% in 1968.

Almost half of the 1968 isolates tested were inhibited by 1.0 mg% or less of sulfadiazine. About 60% of group B and about 23% of Group C isolates were inhibited at this concentration. Compared with the 2 previous years, this is a striking increase in sulfadiazine resistance among the organisms of serogroup C submitted for antibiotic sensitivity testing.

TRICHINOSIS—WASHINGTON, MISSOURI

USDHEW PHS NCDC Morb & Mort Wkly Rep 18(4):31, Jan 25, 1969.

An outbreak of trichinosis with 47 suspected cases has been reported from Washington, Missouri; 8 persons were hospitalized. The first reported illness began 28 Dec 1968, and onsets of additional cases continued. The most common clinical features were periorbital edema, headache, fever, myalgia, conjunctivitis, blurred vision, photophobia, and fatigue. Less than half the patients reported diarrhea or gastrointestinal illness. All patients had eosinophilia ranging from 6 to 59% and which was not consistently accompanied by leukocytosis. The more severely ill patients received thiabendazole or steroid therapy. The diagnosis of trichinosis was confirmed in 2 patients by muscle biopsy. Sera were collected for bentonite flocculation and charcoal card tests; these test results are pending.

Of the 47 patients, 46 admitted eating a locally prepared, uncooked summer sausage. The sausage was prepared from fresh pork trimmings that were seasoned, ground, and mixed with ground beef. After light smoking, the sausage was partially dried without control of temperature or humidity in a "curing room" for 2 to 3 weeks. Laboratory testing of a specimen of leftover summer sausage by pepsin hydrochloric acid digestion demonstrated *Trichinella spiralis*. No larval movement was seen, but the parasites were well preserved and not calcified.

The implicated sausage was voluntarily withdrawn from distribution by the producer at the beginning of the investigation, unsold sausage was impounded by the state department of agriculture, and the sold sausage was recalled. Investigation to locate other possible cases is continuing.

PUBLIC HEALTH—PART II

R. W. Emerson, MD 12(9):129–131, Sept 1968.

Development. The main areas of development in the 19th century were a drive on sanitation, a new focus on statistic studies, a bacteriologic breakthrough, a growth and consolidation of services.

The sanitation campaign in England was led by Sir Edwin Chadwick, a barrister and journalist. Chadwick became a Poor Law commissioner and factory inspector, fought relentlessly to improve working conditions, buttressed his case by collecting statistics that related life expectancy to occupation. In 1842 he published *General Report on the Sanitary Condition of the Labouring Population of Great Britain,* a searing indictment that led to establishment of a General Board of Health. He was named a board member to administer his own reforms, served with such zeal and vigor that an observer said afterwards: "He was the board."

Important collaborators in the struggle included physicians Thomas Southwood Smith, John Simon and William Farr. Like Chadwick, Smith and Simon were first pamphleteering investigators, then powerful officials in the medical service they helped to forge. Farr worked quietly in the background, dug out much of the data; he has been termed the creator of modern public health statistics.

Inspired by Chadwick was Lemuel Shattuck, a Boston book publisher and city councilman. He persuaded the Massachusetts legislature to authorize a seemingly innocuous sanitary survey, got himself appointed chairman of the study and turned it into a massively documented expose. In his *Report of the Massachusetts Sanitary Commission* (1850) he submitted 50 recommendations for radical change; a century later ⅔ of his ideas were common policy.

Louis René Villermé conducted major French inquiries on social factors in health, was best known for his inquiry into the health of textile workers. Belgian mathematician and astronomer Adolphe Quetelet contributed an important technique to the burgeoning statistic studies by working out a law of probability curve.

John Snow and William Budd of England and Ignaz Philip Semmelweis of Hungary all combined statistic evidence, shrewd hunch and empirical observation to track down the contagion factors. Snow traced cholera victims in a London neighborhood to a particular pump, stopped the outbreak in that area by disconnecting the pump handle. Budd duplicated the cholera observations independently, went on to demonstrate the epidemiology of typhoid fever. Semmelweis recognized that puerperal fever was conveyed by the unwashed hands of obstetricians, succeeded after long campaign in introducing sterile procedures which drastically reduced the death rate.

Public health measures soared after Louis Pasteur established the germ origin of disease, Ronald Ross tracked down the Anopheles mosquito as malaria's carrier, and Carlos J. Finlay suspected mosquitoes of carrying yellow fever. The new era was reflected in mortality tables in the period of 1841-1850 the death rate for England and Wales was 22.4 per 1,000; by 1910 it had dropped to 14.7. Even more dramatic was the effect on child mortality; in 1894 the New York death rate among children under ten was 7 per 1,000; a quarter of a century later it was less than 1.

Organization. The 19th century was marked also by appearance of 2 basic public health approaches which set the pattern for much of the world. Russia in 1864 instituted the *zemstvo* plan, administered by provincial councils. It provided salaried physicians, hospitals and other services financed entirely by the government; it was applied at first only to rural districts but was extended to the cities. With modern modifications it is still the system employed in Soviet Russia, East Europe, a number of Asian countries.

A contrasting approach is a plan adapted from the Napoleonic Code by Prussia's Otto von Bismarck. Based on social insurance arrangements it is financed jointly by employers, employees and the government: fees are charged for most services but are generally low; private medicine coexists with public. Again with numerous modifications it is exemplified today in Germany, France, Great Britain, the Scandinavian countries.

In the United States a hybrid federal system developed slowly. It began with the United States Marine Hospital Service to aid sailors in 1798 but 72 years passed before the moribund service acquired a central headquarters with a medical officer in charge. By the end of the 19th century it had been reorganized as the United States Public Health Service; along the way it acquired a laboratory (1887) and responsibility for foreign and interstate quarantine (1893).

Since the 1930's the Public Health Service has grown rapidly, now employs about 35,000 people; the nation's public health program is much larger as service functions are complexly intertwined with those of the Defense Department, Veterans Administration, Agricultural Department, numerous smaller agencies.

Currently under way is a significant reorganization intended to streamline operations. Plan is to group all health services under three major divisions responsible to an undersecretary in the Department of Health, Education and Welfare.

A Consumer Protection and Environmental Health Service will be responsible for such problems as food and drug control, air and water pollution, radiologic hazards, matters relating to urban and industrial health.

A Health Services and Mental Health Administration will embrace all health agencies that give care to individuals, will also supervise regional medical programs of research in heart disease, cancer and stroke.

The National Institutes of Health will maintain the previous institute's function and incorporate the Bureau of Health Manpower and the National Library of Medicine.

World. The most critical difference in public health services lies not in variations of plan but in degree of national development. In prospering industrialized countries research flourishes, contagious and other hazards are controlled, a wide range of services is offered to populations that are basically healthy and well protected. In struggling undeveloped countries health agencies strain desperately to match meager resources against almost bottomless

needs. Sample problems: in some areas the physician-patient ratio is 1:100,000, 9/10 of the water is polluted, diseases long banished from the West still flourish, such as cholera in Asia.

Attempting to bridge such gap is the United Nations' World Health Organization (WHO). It operates currently on a budget of about $50 million a year, calls on the consulting services of some 1,200 scientists and health administrators who act as members of special panels.

WHO conducts wide ranging programs of treatment, research and training, but by far the biggest slice of its budget (more than ¼) is invested in epidemiologic efforts. The largest and most successful attempt so far has been a malaria eradication campaign launched in 1955. About 900 million people have been freed from threat of the disease; current work is aimed at relieving 300 million more.

Summary. Public health means wealth.

EPIDEMIC GASTROENTERITIS, POSSIBLE WINTER VOMITING DISEASE, IN AN ELEMENTARY SCHOOL NORWALK, OHIO

USDHEW PHS NCDC Morb & Mort Wkly Rep 17(47):434–440, Nov 23, 1968.

On 30 and 31 Oct 1968, an acute gastrointestinal illness developed in 50% (116 of 232) of the students and teachers of an elementary school in Norwalk, Ohio. Index cases occurred on the evening of 29 Oct with most cases occurring in the 24-hour period between noon of 30 Oct and noon of 31 Oct. The illness was characterized principally by nausea, vomiting, and abdominal cramps; diarrhea occurred in 44% of the cases. Symptoms lasted from 12 to 24 hours in most instances and seldom more than 48 hours. No patient was hospitalized, and there were no known sequelae.

Family contacts of primary cases also developed the syndrome. The secondary attack rate in these families was 29.8% (113 ill of 379 at risk). This is significantly different from the 3% attack rate in both family contacts of well children who attend this school and in the community at large as ascertained by a telephone survey. Secondary cases occurred predominantly on 1, 2, and 3 Nov with an average incubation period of 48 hours. The attack rate difference between the students' mothers and fathers (37 and 22%, respectively) and between small and large families were not significantly different.

Epidemiologic analysis of primary cases excluded a food-borne mode of spread since students who brought their lunches from home had similar attack rates with those who bought lunch in the school cafeteria. This school, in contrast with the other schools in the system which receive city water, has its own well; this well water could not be excluded as the mode of spread. The one class with the lowest attack rate had the lowest reported use of drinking water on 29 and 30 Oct. Although the water is routinely chlorinated, adequate levels of chlorine could not be demonstrated. Coliform counts on the well water on 21 Oct and 12 Nov were negative. No cross contamination could be demonstrated between the septic tank and the well or between the septic tank and a water softener used to treat water for drinking in the school. Following the investigation, bottled water was purchased for the school until the drinking water could be proved safe.

Stool swabs for bacterial, viral and some parasitic studies and specimens were obtained from primary and secondary cases, as well as from samples of asymptomatic children attending the school, asymptomatic persons from affected families, and food handlers. Throat swabs were also obtained from these individuals. Results of these studies are pending.

Food from the 28 and 29 Oct lunches at the school was not available for culture, but milk and food from the 30 Oct lunch was analyzed for Salmonella, Shigella, *Staphylococcus aureus,* and coliforms. None was recovered. Well water was obtained for bacteriologic and virologic studies.

Editorial Comment. The precise mode of transmission in this outbreak has not yet been ascertained. However, characteristics of the epidemic curves suggest a common source exposure for the primary cases with a person-to-person spread in family contacts accounting for secondary cases. Person-to-person spread was probably responsible for the secondary cases, and consequently, one might expect a significantly higher attack rate in mothers, who have more intimate contact with sick children, than in fathers, and a higher attack rate in larger families (5 or more members) than in smaller families. Although the attack rate in mothers (37%) was higher than in fathers (22%), this difference was not statistically significant. Furthermore, attack rates in large and small families were similar.

The illness is clinically and epidemiologically compatible with winter vomiting disease. This disease has an explosive onset, usually mimics a common source epidemic, presents with either predominantly upper or lower gastrointestinal symptoms, and generally occurs in persons in residential schools between September and March.

Although no responsible agent has been isolated, a viral etiology for winter vomiting disease is suspected. This is supported by the experience of a few investigators who have been able to transmit infection to volunteers through aerosolized and ingested bacteria-free fecal filtrates. However, more than one agent may be responsible for this syndrome.

EXPERIMENTAL USE OF BAIT WITH MIREX LETHAL TO BOTH ADULT AND IMMATURE *VESPULA PENNSYLVANICA* (HYMENOPTERA: VESPIDAE)

B. Keh, N. T. Brownfield, and M. E. Person, Calif., Vector Views 15(11):115–118, Nov 1968.

The use of mirex for the control of the imported fire ant has led to the suggestion that this toxicant could also be used for the control of other hymenopteran pests such as the ground-nesting yellowjacket, *Vespula pennsylvanica*. Because the nests of these wasps are often inaccessible to direct control methods and because food is carried back to the nests to feed the larvae, control procedures using poisoned baits are advantageous.

Mirex is a chlorinated hydrocarbon that is virtually insoluble in water. Technical mirex is a white crystalline material. According to the information on the registered label for mirex bait for the control of the imported fire ant, when the material is used in accordance with the directions given, the ants will usually die in 1 to 2 weeks in hot weather, and 2 to 4 weeks in cooler weather.

A preliminary field trial was made on 11 Aug 1967, in Richmond, California, by the Bureau of Vector Control, California State Department of Public Health, to determine the acceptability of mirex in baits to *V. pennsylvanica*. Ground beef liver and a fruit drink concentrate sold under the trade name, Hawaiian Punch, were used as baits.

Technical mirex was mixed with 3 portions of ground beef liver so that the finished bait had 0.25%, 0.50%, and 1.0% concentrations of mirex; these portions were placed in the vicinity of a yellowjacket nest.

The bait containing the lowest concentration of mirex (0.25%) was the most acceptable, and the portion with the highest concentration was least acceptable. Through the use of marking powders there was a clear indication that workers from more than one nest go to the same food source at the same time without observable conflict.

Drying of the bait reduced the acceptability of all portions so that there was a definite decline in the number of workers attracted on the second and third days. After several days of testing, this experiment was discontinued and the dried bait removed. The marked colony was still active at that time.

About 2 months later (3 Oct) during a visit to the study site, the nest was found to be completely inactive.

On 5 Oct 1967, a new nest was selected and bait acceptability tests were conducted using 5 portions of 10 ml each of Hawaiian Punch with concentrations of mirex as follows: 0.1 g, 0.2 g, 0.3 g, 0.4 g, and 0.5 g. These portions were placed within 2 feet of the nest. All concentrations of mirex offered were eagerly accepted. Due to the viscosity of the fruit drink the technical mirex remained in suspension during the entire test period.

The great attractiveness of the fruit concentrate to the yellowjacket at this time was pronounced, particularly as compared to beef liver. A total of 1.5 g of technical mirex and 50 ml of Hawaiian Punch concentrate was taken in approximately 2 hours. On the following day an additional 1.5 g in 50 ml of Hawaiian Punch concentrate in one portion was again offered and was readily accepted.

Most of the yellowjackets visiting the bait were marked, but unmarked foragers also took the bait. There was a continuous decline in the activity of the nest until 10 Oct when activity was virtually nil and the nest was dug up. Examination of the contents revealed that nearly all the adults and immatures were dead. A control nest some distance away continued to be active.

The inactive nests were dug and dead yellowjackets in all stages of development were examined in the laboratory. It was apparent that mirex does not kill the foraging adults immediately nor prevent their feeding the material to the larvae, and that they transfer the mirex to the larvae whether meat bait or liquid carbohydrate (fruit) bait is used. The detection of mirex in the dead pupae was evidence that some interval of time is required before the toxicant fed to the larvae takes full effect. Mirex was also detected in dead males and one dead queen. The continued activity of the adults after the bait is placed, however, means that nuisance caused by them would not be eliminated immediately. But when the toxicant takes full effect it can be expected that all stages of yellowjackets in nests nearby will be controlled.

CANNIBAL SANDWICHES POSE HEALTH PROBLEM: WORMY MUSCLES CAN RESULT

H. G. Skinner, MD, Dept Health & Social Serv State of Wisconsin, Health 18(8):17–18, Fall 1968.

Some people call them raw ground-round sandwiches with onions on rye. Others call them cannibal sandwiches.

They are good if the beef is pork-free or contains pork not infested by trichinosis worms.

If the meat is infested, 2 to 28 days later the victim can have swelling of the upper eyelids, hemorrhage in the eyes, pain and sensitivity to light. Next comes the muscle pain with fever, sweating and a rise in the eosinophiles of the white blood cells.

Sometimes the heart and brain are affected. These serious symptoms, which on occasion lead to death, occur from the 4-8 week of the illness. Most people recover to take another chance with cannibal sandwiches or raw summer sausages.

A relatively new drug is now available for use against trichinosis, although its value is not known with certainty. In addition, some observers consider the anti-inflammatory effect of steroids valuable when used in these infections.

The larvae are contained in little cysts in pork muscles (also rarely in bears and some marine mammals). Digested free of the meat, they burrow into the intestinal walls and mate within 3 or 4 days. Then the small male (1.5 mm long) dies. The big female (3 mm long) burrows into the intestinal wall and 4 days later begins to discharge her young.

This activity can continue for 6 weeks. The baby larvae (0.1 mm long) gets into the blood via the lymphatics. They live, if they get into the muscles. This is the cause of the pain. These larvae become cysts in 3 months but they can live on for years.

Recently epidemics have been traced to the practice of grinding beef in the same grinder which has previously been used for grinding pork. Another danger is to the cook who tastes raw food, a practice which has resulted in infections. Raw summer sausages also have been involved in epidemics.

Although the first defense is properly fed hogs, the ultimate defense is adequately cooked pork.

The first year no one died of trichinosis in the United States was 1967, also the year reporting the lowest number of cases, 67. Previous lows were 115 cases in 1966 and 160 in 1960. Deaths vary from a high of 15 deaths in 1948 to 1 death in each of 1954, 1962, and 1964. There were 3 deaths in each of 1966, 1965, 1960, and 1959.

Examining the muscles of persons who come to autopsy is one way of estimating the extent of the problem. In the 1930's 15 to 25% of autopsies yielded evidence of such worm infection. In 1960 the rate was about 5%.

Such reduction has resulted from improved feeding practices among pork raisers and greater care in the preparation of pork products. When garbage is fed to pigs it must be properly cooked so that the worms are killed.

SALT: THE FIFTH ELEMENT—PART I

Bea Hopkinson, Mankind 1(9):53–79, Oct 1968.

If all the salt supplies of the world were heaped together we would find ourselves buried in a sea of salt which would cover the world. It is strange, therefore, that until the beginning of the 12th century salt was considered a luxury for at least ⅔ of the world's population—its value such that when Italian troops marched into Ethiopia before World War II it was found held in bank vaults as financial reserves.

The value of salt, other than financial, has been recognized by man since the beginning of time. One Parisian writer of the 16th century, Jean de Marcounille, suggested salt be described as the *fifth* element because it was considered so universally necessary to life.

A man needs a quarter of an ounce each day to survive, maybe more in a warm climate where the salt content of the body is lost in perspiration. Since too much salt is as bad as not enough, a balance is maintained in our bodies by the action of the kidneys and adrenal glands. Weakness can be caused when there is a loss of salt through excessive perspiration. Particularly in times of war, when men are fighting or energetically exerting themselves, intake of salt and its ready availability is imperative.

Julius Caesar, the Roman general who engaged in conquest after the 1st century B.C., took along *salinators,* or saltmen, as a matter of course so his centurions would have salt supplies en route—an

important factor obviously lost on later generals. Napoleon reflected "Salt is the *sine qua non* in a soldier's wartime diet" after a disastrous winter campaign in Moscow when his troops had perished by the thousands because they were suffering from a salt deficiency which prevented their slightest wounds from healing! In the Paraguayan War of 1864 troops died for the same reasons.

Both ancient and medieval man believed salt contained mythical properties which could only be attributed to the gods. This fact is explainable when one understands that salt—or sodium chloride—exhibits properties which are the exact antithesis of each other, seemingly, therefore mythical. To tamper with ancient methods of obtaining salt, they thought, was sacrilegious as well as dangerous. As a result those who partly understood the mineral resisted attempts by outsiders to learn more about its secrets.

Salt is an ingredient of many of the rocks that make up the earth's crust. As rain strikes these rocks and wears them away. Dissolved particles of salt are carried into brooks and streams and rivers which drain into a marsh, a lake, or the sea. Rocks of halite, or salt crystal, may push themselves up from the bowels of the earth and springs bubble to the surface in the form of brine. Brine is water which is 350,000 parts per million, or 35% saline. Lakes like Salt Lake in Utah and the Dead Sea between Israel and Jordan are heavily saline saturated with 250,000-270,000 parts per million salt.

The oldest form of salt production was solar evaporation of seawater. Depending upon how much fresh water empties into it, seawater varies in salinity. Generally it is considered to be 35,000 parts per million or 3½% saline. But the seas of the Arctic, where huge glaciers melt into it, are considerably less saline than the Mediterranean which is particularly high. Solar evaporation does not hinge on salinity only; equally important are climatic conditions, either hot, dry, and windy or otherwise predisposed to the evaporation of pools of brine.

It is significant that one such place, the Mediterranean Sea, became the world center for trade and in addition fostered sophisticated civilizations like those of the Egyptians, Greeks, and Romans. Certainly Julius Caesar, who traveled further north, east, and west than any man before his day, knew more about salt than did the primitive tribesmen he conquered.

Early Germans set logs afire before throwing seawater over them. A salty residue was left on the logs after the water evaporated off in steam. The English placed logs in kettles of boiling seawater.

Today, in parts of Thailand, less advanced peoples still make salt this way. The ancient Chinese boiled salt plants in kettles of seawater over a fire made of salt weeds. The liquid was reduced by evaporation until an egg would float in it—brine being more buoyant than fresh water. Some early peoples like the Polynesians and California Indians simply cooked their food in seawater.

A treatise on pharmacology, written about 5,000 years ago in China called the *Peng-Tzao-Kan-Mu,* discussed 40 different kinds of salt and methods of extracting it—some amazingly similar to processes used today. In northern climates where solar evaporation was impossible, brine had to be boiled to aid precipitation of salt crystals—for which enormous amounts of fuel were required. Six thousand loads of young pole wood from nearby forests were used in furnaces at Droitwich, England, in 1540, and still each furnace could produce only 4 loads of salt a year because there was not fuel enough for more.

Good indications of geographical differences in the abundance of salt were the lead salt pans used by Englishmen which were 25 inches square with a capacity of only 7 gallons. In contrast Roman salt pans of similar design had a capacity of 20 gallons of brine. When techniques improved later these pans became much larger. Iron pans were tried for the first time in England in 1565, but because they required large quantities of wood to heat them they did not go into general use until about 200 years later when good grade coal fuel was substituted for wood.

Concurrent with man's basic need for salt was the development of new uses for it. Since the beginning of time salt was man's only means of preserving hides. Ancient Egyptians salted a species of sardine and other game found in or around the Nile. Early Phoenicians who were great sailors and fishermen salted their surplus fish to trade for other goods along the ports of the Mediterranean. The practice of preserving food, therefore, was an ancient practice and was the only means of keeping meat sweet for crews of old sailing vessels during long voyages.

Apart from its preservative qualities, salt is most precious to man's cuisine, for in almost all recipes, whether sweet or sour, salt will enhance the flavor. The uses to which salt was and is put are endless. The soap and enamel trades use it, as do potters to glaze and harden pots. Glassmakers and smelters

use salt as a flux, while in dyeing processes it is used to set the color.

Salt was also the first medicine for man and beast alike. Sailors believed it guarded against constipation and prevented scurvy and scrofula. Babylonian and Egyptian doctors understood something of the properties of salt and employed brine as an antiseptic when preparing bodies of their illustrious dead for embalming. Moreover, because of "mythical" properties, salt was of religious and cultural significance for thousands of years for people in many lands. There are over 30 references to salt in the Bible. Used by the Church of Rome in the baptismal rite, salt is also contained in the holy water sprinkled on the congregation at Sunday Mass.

Because of its preservative qualities, salt served as a symbol of incorruption and of immortality. So Russians placed it in the coffins of their dead. In the north of England ancient Scots used salt in a ceremony purported to send the soul to heaven! Salt was also considered an emblem of justice, and it was thought 2 people who ate salt together could not become enemies. Consequently men used salt to seal an agreement.

At birth Arabs rubbed their children with salt to ward off evil spirits. When a child turned out to be not too bright they would say, "It was not salted at birth!" But symbolic meanings, like the qualities of salt itself, can also be the antithesis of each other. The Hopi Indian in Arizona's southern desert had a "Salt Man" as their war god, while a "Salt Woman" for the Navajo Indian in New Mexico is holy.

Because of its basic value in the order of things and because trade stemmed, at least for the Western world, from the sophisticated civilizations of the Mediterranean, possession of salt was reckoned in terms of money or wealth. Trade, originally carried on by bartering, became hampered by the bulk of basic commodities. Yet desirable items like wampum beads of polished shells did not displace the worldwide use of salt as money. Its use was widespread in Abyssinia and other parts of Asia by Mongol emperors. African natives carried salt in cylindrical cases of palm leaves. It cost 10 to buy a wife!

Roman rulers issued salt as *viaticum,* or traveling expenses, to their far-flung legions. More familiar with the ways of salt than most, they were able to manufacture salt along the way as well as in the countries they occupied. Our word salary originated from the Roman term *salarium,* while *salinae* was a Roman word for places where salt was found.

Eventually the value of salt did shift from its direct use as money to its more realistic value as a raw material. In the Aegean Islands where copper and iron were plentiful, Greeks used these metals in the form of nails called *obols* for money. Six of these made a handful or a *drachma* in Persian currency. Between 800-600 B.C. coins were invented, but not until 300 B.C. when gold and silver became plentiful and were used by weight did trade expand. It was stimulated further when it was no longer necessary to weigh coins after they were stamped with a design showing the value placed upon them was guaranteed.

Men then learned that gold and silver possessed great purchasing power. They reasoned that money was wealth, that the nation that possessed the most money in actual coinage was the richest, and in order to earn more money more goods must be sold abroad than were bought in order to create a favorable balance of payment in trade. An effort was made to regulate trade and in this effort the exploitation of raw materials, particularly salt, was of prime importance.

Since salt was drawn mainly from the sea, inland deposits were slow to be exploited, and it was necessary to transport salt from the coast to the interior by cart, packhorse, camel, or boat—a precarious business which finally lent importance to the development of inland deposits. This factor became significant in the expansion of new territories. In the New World, for instance, advances made by settlers on the farming and ranching frontiers were partly limited because they were tied to the coast for salt supplies. In 1752 when Bishop Spangenburg sought lands in North Carolina for a colony, he wrote, "They will require salt and other necessaries which they can neither manufacture nor raise. Either they must go to Charleston in South Carolina or Boling's Point, Virginia, both 300 miles distant." Census reports and maps of the period show how tongues of settlement pushed forward. This pattern was in part due to Indian resistance, in part due to the location of fertile and favorably situated soils reached through river valleys and passes with army posts nearby to protect settlements, and in part due to the location of salt deposits.

Daniel Boone, the famous backwoodsman, who combined the occupations of hunter, trader, cattle raiser, farmer, and surveyor, left his Pennsylvania home with his father to pioneer the rich pastures of Kentucky and Missouri. Like other colonists he went to great lengths to obtain salt supplies. As he and other pioneers pushed westward they followed salt lick trails as they went. But often they would

have to carry it with them over the Alleghenies to the Pittsburgh markets where it sold for as much as $10 per bushel. On the great plains, where salt licks were rare, herders often threw salt on the ground for their animals before commercial licks became common.

It was not until the mid-19th century in North America that rock salt was discovered while drilling for oil and gas. Two great natural sources of solar salt were discovered about the same time—the Great Salt Lake in Utah and the natural reservoirs along San Francisco Bay. Until then salt production on a commercial scale was carried on only in a limited way.

KNOW YOUR WORLD

Did You Know?

That preschool and school age children in New York State will be required to receive immunization against measles, smallpox, and poliomyelitis before entering school?

Effective 1 January 1969 a new State Law, Section 2164 of the Public Health Law became effective.[1]

That the death in Nov 1968 of Typhoid Mary, at the age of 70, has brought to an end a much-publicized period of nearly 30 years' isolation in a New York City institution?

Although she may appear no more in the news, Mary Mallon will live forever in medical annals. From 1907 to 1910, while incarcerated by Health Officials, Mary sought release by legal means. The New York Supreme Court upheld the community's right to keep her in isolation. In recent years it has not been necessary to confine a typhoid carrier, modern control methods being based on frequent supervision of the carrier in the home. However, the established right of the community to require isolation has been applied to other chronic contagious diseases, notably in the cases of careless or dangerous tuberculosis patients. Typhoid Mary Mallon had the ill fortune to bring illness directly to hundreds. Yet because of the drama of her life, her compulsory and self-imposed confinement—features that attracted and focused the glare of publicity on the role of typhoid carriers in the occurrence of disease, she has been the agent for formulation of public health procedures which have and will continue to prevent many times the number of typhoid cases that she caused.[2]

That from the rubella epidemic in 1963-1964, the March of Dimes estimated:

Total cases—10 million
Incidence in females 15-44—1.9 million
Number of pregnant women infected—247,000
Number of infected women in first trimester—82,000
Fetal deaths (estimated at 30-36%)—8,000-30,000
Birth defects (28% of liveborn)—15,000-20,000
Total affected—23,000-50,000 [3]

That hepatitis is once again on the rise with more than 37,000 cases from 1 July 1966 to 30 June 1967, and over 44,000 cases in the 12-month period ending 30 June 1968? This reverses a 5-year downtrend from the previous high points of 1960-61.[4]

That 1,115 cases of arthropod-borne encephalitis with 2 deaths occurred from 20 Oct to 7 Dec 1968 in Venezuela?

These were attributed to equine encephalitis virus reported from Zulia State—Paraguaipoa, Sinamaica, Yaguasirú and Carrasquero, north of Maracaibo.[5]

That in 1968, 9 outbreaks of botulism with 10 cases including 3 deaths were reported while in 1967, only 3 outbreaks with 6 cases and 1 death occurred?

Of the 9 outbreaks in 1968, 8 were foodborne and 1 was a wound botulism. Contaminated vehicles included fish cured in seal oil and buried underground for 6 months by the Eskimos, home-canned chicken soup causing type B botulism, vegetables, fruit preserves, improperly cooked hamburger, and commercially prepared chopped chicken liver causing type A botulism.

A total of 21 requests for botulism antitoxin or epidemic investigation of suspected outbreaks of botulism were received by the NCDC, Atlanta, Ga.[6]

That a total of 24 deaths directly related to football occurred during 1967 in the United States?

Of these 19 occurred in high school, 5 in sandlot

and 3 in college football. There were no professional fatalities. Five football fatalities associated with such causes as heat stroke, heart failure, or infections, occurred in 1967; 4 of these deaths were in high school players and 1 in college athletics.[7]

That the "house dust mite," *Dermatophagoides pteronyssinus,* is closely associated with the allergenicity of house dust and may be the major source of house dust allergen?

In a large number of dust samples from houses of patients with bronchial asthma, the mites were identified and counted. The most common species, named above, was most abundant in mattress dust. Skin reactions to *D. pteronyssinus* extracts occurred in 94% of the patients sensitive to house dust. Asthma patients who were negative to house dust were also negative to this mite.[8]

That calcium hypochlorite used as a bleach may spontaneously ignite when mixed with certain rinse additives (presumably fabric softeners)?

Hospitals and nursing homes have been advised already by the Injury Control Program of the Public Health Service. At a Job Corps camp where the chemicals were accidentally mixed in a cardboard container, the container burst into flames.[9]

That a new water-based chemical oil dispersant called "Corexit 7664" is said to break up oil slicks without harming marine life?

The amber-colored liquid can be sprayed from a ship and breaks up the oil slick into fine particles amenable to biodegradation. The agitation caused by the ship's wake helps disperse the chemical quickly. The manufacturer says that all tests conducted so far have shown that it is completely harmless to marine life.[10]

That from 6 Oct to 2 Nov, 64 cases of dengue have been reported in the parishes of Clarendon—32; St. Thomas—20; St. Mary—11; St. Elizabeth—1?

The cumulative total for 1968 was 128 reported cases as compared with 4 in the corresponding period of 1967.[11]

That the government of Japan has proclaimed Minamata disease a public hazard?

People who ate fish caught in the Aganogawa River in the Minamata Bay area often were stricken with a peculiar neurologic disease, poisoning by methyl-mercury compounds. Public Health officials are doing all possible to prevent poisonous industrial wastes containing mercury from being dumped into the water of the Aganogawa River.[12]

That in 1749 Sweden was the first country in the world to conduct a census?

The results were kept a state secret, because it was considered dangerous to reveal to foreign powers the small size of the population. In 1947, Sweden established another "first" in population registration: the numbers system. Every Sweden man, woman, and child—has a 9-digit identification number, composed of his or her birthdate, sex, etc. By means of these numbers the government is assured of efficient and mistake-proof handling of voting-tax collection, social security, marriage, divorce, death, military service.

Only Israel and Holland have similar systems.[13]

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EDITOR'S SECTION

PREPARATION OF TISSUE FOR SPECIAL MICROSCOPY OF THE KIDNEY BIOPSIES

Electron microscopy of kidney biopsies is a time consuming procedure justified on special occasions when the glomerular changes are equivocal on light microscopy. Electron microscopy is of particular value in differential diagnosis of the nephrotic syndrome and with focal, early, or minimal glomerular disease.

Special handling of the tissue is required in such

cases and the following simple procedure has been found necessary to provide both for light and electron microscopy.

The entire kidney biopsy should be placed in 20-30 cc of the cold fixative (0°-4°C) (see below) immediately and maintained in the refrigerator over night at the same temperature. *Do not place in freezer. Do not refrigerate below 0°C.* The fixative should be changed the next day and the specimen placed in the container, with 20 cc of the solution, properly labeled with the name of the patient. AFIP Form 174A (Test) 1 Nov 1968, which may be obtained from AFIP, should be filled out by the clinicians in triplicate and should accompany the specimen. The container and the forms should be shipped by special delivery air mail to: The Director, AFIP, Washington, D.C. 20305, ATTN: Special Reference Laboratory For Renal Biopsy.

The laboratory will return duplicate slides appropriate for light microscopy as well as a report of the findings and, where indicated, electron micrographs with descriptions. Two copies of the completed forms will be returned to provide one copy for the laboratory the other for the patient's records.

Preparation of Solution

A. 0.2M solution of $NaH_2PO_4 - H_2O$ (sodium phosphate monobasic) 27.6 g in 1000 cc of distilled water.

B. 0.2M solution of Na_2HPO_4 (sodium phosphate diabasic anhydrous) 28.4 g in 1000 cc of distilled water.
Stock solutions (A&B) will keep for several months if refrigerated (0°-4°C).

C. Phosphate Buffer at pH 7.3 – 7.4.
Mix 11.5 cc of sol A, with 38.5 cc of sol B. Dilute to 100 cc with distilled water. Check pH and adjust as necessary. pH very critical.

D. To make Glutaraldehyde* 5% solution:
Add 10 cc 50% glutaraldehyde (biological grade) to 90 cc of phosphate buffer pH 7.3 – 7.4. (Good for approximately 1 week if kept in the refrigerator but preferable to use fresh sections.)

E. Ship biopsy in container with at least 20 cc of above fixative.

F. Store all solutions in refrigerator 0°-4°C.

*Fisher Scientific

*Union Carbon and Carbide Company

*Eastman Kodak Company

—AFIP, Washington, D.C.

PUBLICATIONS AVAILABLE

The Preventive Medicine Division has a limited supply of two publications available for distribution to interested parties. These are: *Snakes of Taiwan* by CAPT Robert E. Kuntz, MSC USN, (NAMRU-2) and the American Public Health Association's Tenth Edition (1965) of *Control of Communicable Diseases in Man.*

Copies of these publications can be obtained by writing BUMED (Code 72), Navy Department, Washington, D.C. 20390.

If copies are not received within six weeks, requesters can assume supplies have been exhausted.

MEETING OF THE SOCIETY OF MILITARY ORTHOPEDIC SURGEONS

The Society of Military Orthopedic Surgeons (S.O.M.O.S.) will hold its eleventh meeting at the National Naval Medical Center, Bethesda, Maryland 20014, on 22 through 24 September 1969.

Professional papers are requested for presentation at this meeting and further inquiries may be addressed to Captain Robert H. Brown, MC USN, Naval Hospital, Bethesda, Maryland 20014.

Reserve Officers are invited and may apply for this meeting via their district command.

USAF SOCIETY OF AIR FORCE CLINICAL SURGEONS' SYMPOSIUM

The Department of the Air Force has reserved 20 spaces in the U.S. Air Force Society of Air Force Clinical Surgeons' Symposium for the Department of the Navy. The symposium will be conducted at the USAF School of Aerospace Medicine, Brooks Air Force Base, Texas, during the period of 26 to 28 May 1969.

Interested medical officers may obtain detailed information relative to content of the program by forwarding inquiries to the USAF School of Aerospace Medicine.

Requests for quota should be made to BuMed Code 316. Funding may be requested pursuant to SECNAVINST 4651.15A.

Officers should report to the School no earlier than 1200 and not later than 2400 hours, 25 May 1969.

SECOND ANNUAL SYMPOSIUM ON TRAUMA

On April 25th and 26th, the Naval Hospital, Camp Pendleton, California, will sponsor its Second Annual Symposium on Trauma. The success of last year's meeting, which stressed combat surgery, was attended by over 450 physicians and provided the impetus for the second symposium on trauma. This year's program will stress not only combat surgery but will also include the wide range of trauma encountered by both military and civilian hospitals in general.

Setting the keynote for the meeting will be Colonel John P. Stapp, Medical Corps, U.S. Air Force, currently assigned by the Defense Department to the Department of Transportation, Washington, D.C. Colonel Stapp is best remembered for his studies from 1946 through 1958 on rapid deceleration. These dynamic stress analyses provided criteria for aircraft and ground vehicle safety design. As a volunteer for 29 of the rocket sled deceleration and windblast experiments, Colonel Stapp sustained decelerations of 25 g average and 40 g peaks during a stop in 1.4 seconds from a velocity of 632 miles an hour attained by a rocket sled in 1954. The title of Colonel Stapp's Keynote Address will be "Mechanisms of Injury."

Other physicians who will present papers at the meeting include Dr. Allen Nahum from the Division of Trauma Surgery, UCLA Medical Center, who will speak on the "Mechanisms of Injury Production and Vehicular Collision"; Dr. William Caveness from the National Institute of Health, Bethesda, Maryland, who will speak on the "National Importance of Head Injuries"; Dr. John E. Scott, M.D., Ph.D., from the Department of Health, Education and Welfare, Washington, D.C., who will speak on the "Design and Staffing of Emergency Rooms."

There will also be panel discussions on "Advances in Surgery and Anesthesia in the Management of Trauma." Dr. Marshall J. Orloff, the Professor and Chairman of the Department of Surgery, University of California Medical School, San Diego, will moderate this panel. The panel on "Advances in Head and Neck Trauma" will be moderated by Dr. Irvin Rappaport, D.D.S., M.D., the Director of Surgical Services at the Orange County Medical Center. A panel on the "Battered Child Syndrome" will be moderated by Dr. C. Henry Kempe, Professor and Chairman of the Department of Pediatrics at the University of Colorado Medical School. Dr. Howell E. Wiggins, Chief of Orthopedics, Mercy Hospital, San Diego, will moderate an orthopedic panel on "Orthopedic Trauma" which will include Lieutenant Colonel Joseph Moll, U.S. Army, from the Brooke General Hospital, Fort Sam Houston, Texas, Dr. James Wilson, Orthopedic Hospital, Los Angeles, and Captain Frank Golbranson, Medical Corps, U.S. Navy (Retired) from San Francisco. Dr. Nicholas Halasz, Assistant Professor of Surgery, University of California Medical School, San Diego, will moderate a panel on "Current Research in Trauma." In this panel the contribution of the Tissue Bank at the Naval Medical Research Institute at Bethesda, Maryland, will be summarized by Commander Kenneth W. Sell, Medical Corps, U.S. Navy. Recent data accumulated by the Shock Research Unit at the Naval Support Activity Hospital, DaNang, Vietnam, will be presented by Lieutenant Herbert Proctor, Medical Corps, U.S. Navy Reserve.

Dr. E. Paul Woodward, the Team Physician for the San Diego Chargers, and Dr. Wade Eckert, the Director of the Mammoth Mountain Orthopedic Clinic, will headline the panel on "Sports Injuries."

The Deputy Surgeon General of the Medical Corps of the U.S. Navy, Rear Admiral John W. Albrittain, Medical Corps, U.S. Navy, will be the speaker of the evening at a banquet Friday evening, April 25, 1969.

Elements of the Fifth Marine Division stationed at the Marine Corps Base, Camp Pendleton, are cooperating fully with the plans for the Trauma Symposium and will participate in a combat demonstration on the afternoon of the 25th.

Civilian and military physicians and their wives are invited to attend this symposium. A varied program of wives' activities has also been planned for the 2-day period.

Advance registration to the symposium is required and registration and reservations for the banquet may be secured by writing the Commanding Officer, Naval Hospital, Camp Pendleton, California 92055.

NATIONAL CONFERENCE ON BREAST CANCER

The National Conference on Breast Cancer will be held at the Shoreham Hotel, Washington, D.C. on May 8, 9, 10.

Reserve Medical Department Officers attending this conference may receive retirement point credit by certifying their own attendance to the Naval Officer Record Support Activity, 30th and Fort Streets, Omaha, Nebraska 68111.

The Conference Chairman is RADM Wendell G. Scott, MC USNR (Ret).—Reserve Section, BuMed.

DEPARTMENT OF THE NAVY

BUREAU OF MEDICINE AND SURGERY

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